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THE ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD.

Undoubtedly one of the most important excursion routes in the country of any considerable length is that from Philadelphia to Atlantic City. This route has been well served by two steam railway companies, and is yearly traveled by thousands of passengers. The conversion of one of the two lines owned by one of the companies, the West Jersey & Seashore Railroad, which is operated by the Pennsylvania Railroad Company, to electric traction during the present year is for this reason a very significant development. The route itself is sixty-four miles long and demands frequent express service, as well as good local service at one end; and, at the same time, the route selected has a fairly heavy freight traffic. The advantages of electric traction for meeting the passenger requirements undoubtedly led to the adoption of the new system, although it was believed by the engineers that the new system offered considerable advantage for handling the heavy coal traffic.

As the road is almost entirely in the country, and there are no heavy grades nor peculiar local conditions enforcing a change, the new system is exceptionally noteworthy. There is no doubt, however, that the heavy summer travel had a good deal to do with bringing about the change. The first part of a complete description of this interesting road will be found on another page of this issue.

SENSIBLE REMARKS UPON TECHNICAL EDUCATION.

At the recent dedication of the new engineering building of the University of Pennsylvania a number of eminent engineers and educators made noteworthy addresses. One of these, because of the sensible criticism made of certain educational practices, deserves to be widely read. This was the address delivered by Frederick W. Taylor, president of the American Society of Mechanical Engineers. The theme of the address was a comparison of university and industrial discipline and methods, and the speaker called attention to the lax discipline which often prevails in colleges. The young man just entering college leaves the rather strict discipline of school, where he is treated as a boy, and is at once thrown, to a large extent, upon his own resources, it being assumed that he is now a man. The sudden transition, in many cases, proves disastrous to the young man, who does not at once realize the seriousness of the work which he has undertaken. And this condition is not made any better by the so-called elective system, which permits any student to select any study towards which he feels an inclination. In fact, during the four years which the young men spend at college they are

under less discipline than ever before, and have greater freedom than most of them will ever have again.

Regarding the elective system, Mr. Taylor speaks as follows: "Commercial, manufacturing and other enterprises in which men cooperate are managed more and more by delegating all important decisions to a few men whose judgment has been trained through long experience, study and observation in those matters which they are called upon to decide. Yet many of our universities are managed by giving over to the young man, under the elective system, the final decision as to what studies will best fit him for his life's work, although he has, of necessity, but the vaguest idea of the nature of the subjects before him." The logic of this argument is evident, but it should be pointed out that this liberty of selection does not obtain in engineering courses, in which the work is rigidly prescribed—in some cases almost too rigidly. And it is not the function of a technical paper to decide how non-technical courses shall be given.

Regarding the liberty of action in other ways, much may be said both for and against it. Some time or other the boy must be made to realize that he is a responsible person, and he must therefore think before acting. He can not have a set of rules to guide every action throughout his whole life. He must learn to consider what will be the result of every action before it is taken, and he must be made to realize of what he is capable. In other words, the man must find himself, and he will not do this as long as he is treated as a boy.

The sudden transition from school life to university life, in many cases, brings about the desired result. In other cases it is disastrous. It is a question whether a transition period might not be arranged which would save many of those who go to pieces if they are stood too suddenly on their own feet. Mr. Taylor suggests that it would be well for every student to spend six months in some business establishment at the end of his freshman year, as this, by bringing him in contact with actual work, would prove to him that life is in earnest, and must be so treated. Such an arrangement would be rather difficult to make from the standpoint of the college, and there would be considerable difficulty in enforcing it in the spirit, and not merely in the letter. That some good would be effected can not be doubted, if a comparison may be made with the work of those students who enter college after having been at work for some time. These men have a definite purpose in life which they are striving to accomplish. Their college work is a serious matter with them, and, in fact, in very many cases, great sacrifices have been made in order that it may be taken up. Every instructor realizes the steadying tendency on the whole class of a few such students. To these men their studies are work of the most serious kind; while, on the other hand, even the average student would feel, to some extent, that his six months of business was a sort of holiday, and he would return with the feeling that there were still three years of school life before life began in earnest. It is, of course, the function of the college education to prepare men for actual work in life, as well as to give them certain desirable mental training. That they are not always successful is to be expected, particularly if one considers how much more is expected of the college man to-day than some years ago. And it is hardly to be expected that all colleges can keep four years in advance of commercial and industrial development.

However, the whole fault for the present ills should not be laid to the college. Our present school systems are not quite perfect; in fact, fault may be found with the most elementary school. Mr. Taylor touches upon a fundamental trouble when he says: "Somehow the average kindergarten child gets a firm conviction that it is the duty of the teacher to make things interesting and amusing, and from this follows soon the notion that if he does not like his studies and fails to learn much it is largely the teacher's fault." And can the child be blamed for this feeling if the teachers of the higher schools are told that it is their place to teach, and not that of the child to learn? How can any progress be made without a corresponding effort? If a child be too young to make any mental effort, the question may properly be asked, "Then why is he sent to school?"

A NEW WIRELESS TELEGRAPH RECEIVER.

At the recent meeting of the American Institute of Electrical Engineers, Dr. Lee De Forest described a new type of wireless telegraph receiver which he has named "audion," and which he believes offers great possibilities of advance in the wireless art.

As more experience is gained in wireless telegraphy we find that there seem to be innumerable ways of constructing devices which will be sensitive to Hertzian waves. There is nothing novel in this phase of wireless development, for the same was found true in other branches of the art. In the telephone field, for example, it is possible to make a workable instrument out of almost anything; but the main thing, of course, is to construct a device which will give the maximum effect, and which is, above all things, always under control and reliable. Wireless receivers may be constructed in many ways. There is the imperfect-contact type, the magnetic type, the electrolytic type, and now we have the vacuum-tube type. The trouble with some of the earlier forms of apparatus seems to have been that they depended for their action upon a feature which was in itself undesirable. For example, the imperfect-contact type will, unless special precautions are taken, from the very nature of the thing offer different degrees of sensibility from moment to moment, a feature most undesirable in an instrument intended for practical use. Reliability, as said before, and constancy are two essentials.

A feature of Dr. De Forest's new receiver is what he calls its self-tuning properties. The device is, in brief, a peculiar type of incandescent lamp provided with one or more electrodes within the bulb. When the filament is brought to incandescence an electric current may be caused to pass between it and the electrode and through a suitable circuit without the bulb, and if a telephone be included in this circuit it is found that it gives a sound whenever the device is subjected to Hertzian waves. The device may be adjusted by varying either the current through the filament or applying a varying potential in the circuit between the filament and electrode, and this adjustment seems to be practically independent of the natural period of oscillation of the aerial system; in fact, the device seems to depend

for its action upon the total energy received by it during the entire period of vibration of the oscillating system, and not upon the maximum intensity of the first impulse. This feature would seem to be of considerable value, as one of the difficulties in wireless telegraphy is to concentrate upon the receiver sufficient energy to operate it.

Further, the fact that the apparatus seems to be more or less independent of the period of vibration of the aerial system, but is affected by a change in the spark frequency of the exciting coil, would make interference of neighboring stations easy to avoid, as it should not be difficult to maintain a definite sparking frequency, while it is difficult to set up in the aerial a simple harmonic oscillation. This has been one of the stumbling blocks encountered by those engaged in developing wireless-telegraph systems.

The apparatus itself, from a mechanical standpoint, possesses considerable advantages. It is easily transportable, and would seem to be little affected by vibration; and we are now so familiar with incandescent lamp construction that we should be able to construct the device without any great difficulty.

FOOLISH TESTIMONY.

Every one must realize the harm that is done by those charlatans who prey upon the real or imaginary ills of foolish people by proclaiming to have discovered wonderful cures for all diseases. Naturally, a good many of these enterprising men claim to have electrical remedies, thus making use of the belief among the ignorant that electricity can do anything. Such men do a great deal of harm; but there is, as well, another class which is responsible for a great deal of trouble and unhappiness. An instance of this kind is mentioned in one of our contemporaries, which we regret to say, endorses the absurd statements to which it gives publicity, so far as we can see, simply for the reason that it is devoted to an industry frequently supposed to be a competitor of electric lighting.

The cause of the trouble was the breaking of a trolley wire in the city of Chicago. This wire fell apparently across the track, causing a violent arc, which temporarily blinded a small girl who happened to be standing near it. The wire, it appears, did not touch the girl, but the shock from the startling phenomenon caused, so the doctor who was called in claims, paralysis. If the doctor had been satisfied to let his case rest here no criticism could be made, although it would remain to be proved whether the girl's condition was due to the shock; but he was not satisfied, and went on to testify before the court as follows: "The girl's condition emphasizes what is happening daily, in a milder form, in every city. The whole atmosphere became charged from the swinging wire, and within 200 feet or more was like an immense Leyden jar. Every one within that radius would have been affected. The current was not so diffused at her distance, and she was affected more strongly." If this argument were worth disproving it would be interesting to know how a large body of free air can resemble a Leyden jar. If the quotation, as given, is correct, the ignorance of the physician is apparent.

If further evidence be necessary the following would be sufficient, for he said, according to our contemporary: "Delicate persons in this age are being constantly affected by electric currents. Almost any person feels a current pass through his body when riding on a street car and the trolley comes off. It is not so much a shock from the light alone, but from its accompanying current." Evidently he does not realize that every time the car stops the main current is shut off and this should cause just as much of a shock as the jumping of the trolley.

To quote further, he says: "These apparently trivial electrical disturbances, the use of electric lights, and its presence in hundreds of other forms, are the cause of so much trouble to the eyes. Eventually the human race will be blind from the increasing strength and influence of electricity. Sight will be the first of our faculties to vanish." It is rather remarkable that these views should be endorsed by a journal which advocates a form of illumination having very great intrinsic brilliancy, as it is a well-known fact that the intrinsic brilliancy of an illuminant is the one factor which most seriously affects the eye.

Our contemporary goes on to say: "The doctor's evidence is but in line with a vast amount of testimony that is constantly coming to the surface, bearing up[on] the electric peril. It should be an eyeopener to those communities that are considering the question of lighting and are not yet committed to electricity." Could any more absurd bosh be found in a journal in which one has a right to expect some evidence of technical knowledge and common-sense?

ELECTRIC LIGHTING IN A ZOO.

The mortality of some tropical birds of long natural life in the aviaries of zoological gardens has long been a problem in such institutions.

The efforts to maintain the natural temperatures and even humidity which prevail in the tropical regions forming their habitats, and to provide their natural foods, have proved futile as to the results.

Another cause for this difficulty has been found to lie in the feeding habits of the birds, which are based on the approximately equal divisions of day and night prevailing throughout the tropics.

It appears that it has been found from the observations of explorers that in the tropics many of these birds wake at sunrise and obtain their food, and also feed again before sunset.

The long nights of Winter in the Northern climates deprive these birds in captivity of their food for an unnaturally long time, and this condition has been relieved in a certain zoological garden where the portions of the aviary containing such tropical birds are lighted by electricity at six o'clock in the morning, when the birds awaken and feed. The lights are turned on again in the afternoon and these quarters are as daylight until six o'clock in the evening.

After all, the old-time query as to whether the crowing of the chanticleer at sunrise is due to instinct or to observation, leads to some interesting parallelisms in the questions of conditions of bird life.

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

VIII—The Use of Softening Re-Agents and the Tests Necessary to Regulate Their Amount.

(1.) Advantages of Softening—The importance of pure water for the supply of steam-boilers has only been recognized in recent years, and the great extension of the water-softening industry since 1895 is largely due to this fact. There is some danger now, however, that boiler engineers may run into the other extreme, and that they may, by unwise use of softening re-agents, produce greater evils than those they desire to remove.

A water containing chemical salts in solution is just as likely to produce harmful results inside the boiler, when these salts have been added by the user for the purpose of purification, as when they occur naturally. The excessive use of caustic soda and sodium carbonate in many boiler plants is undoubtedly responsible for some of the corrosion of boiler plates and fittings.[2] For steaming purposes a water containing little or no foreign matter in suspension or in solution is desirable, and the purer the water is, the more free from trouble will be the boiler in which it is used. Even dissolved gases (oxygen and carbonic acid) may produce much harm when liberated inside a boiler, and a large proportion of the pitting of boiler plates noticed just above the entrance of the feed-water supply pipe is due to these gases. The water used for steam generation in steam boilers should therefore be as free from solid, liquid and gaseous impurities as it is possible to obtain it. As already stated in the previous article, water containing more than fifteen parts total solids per 100,000 of water, or ten degrees of total hardness, ought to be purified before use.

The treatment of the water with softening chemicals should occur in special apparatus outside the boiler. To carry out the softening treatment inside the boiler is likely to aggravate some of the evils it is desired to avoid.

The proper control of the feed-water of the boiler can only be exercised by aid of systematic and constant sampling and testing of the water, as it enters and leaves the softening apparatus. Occasional tests of the feed-water before and after softening treatment are useless.

In the first place the character of the supply may change from week to week and even from day to day. In many localities the rainfall is the chief agent in causing this variation in the amount of suspended and dissolved impurities present in the natural water supply, in others the dictum of the city water engineer, who, as a rule, has more than one available source of supply. Secondly, the softening apparatus even when of the automatic type requires checking, for owing to this variation in the composition of the natural supply, there is grave danger of excessive chemicals being used at times in the softening operation, and these as already stated may be almost as harmful as the original impurities of the water.

With pure water a boiler may run from 1,000 to 2,000 hours without cleaning, and the evaporative efficiency during this period, owing to the absence of scale, will remain high. With dirty and impure feed-water, on the other hand, the limit of safe work is 500 or less hours, and the evaporative efficiency will fall rapidly towards the end of this comparatively brief working period. It is evident, therefore, that in the majority of works, a water-softening plant will prove a wise expenditure of capital, for it will increase the capacity of the existing boiler plant and reduce the fuel consumption at one and the same time, with only a slight addition to the daily working costs.

(2.) The Chemistry of the Softening Process—The chief salts that can be removed from water by the use of softening chemicals are the carbonates and sulphates of lime and magnesia. Taking these seriatim we have the following:

1. Calcium Carbonate. Chemical symbol $CaCO_3$—always present in natural waters as bicarbonate—$Ca(HCO_3)_2$. This salt can be removed: *a.* By boiling the water. This method yields a precipitate of calcium carbonate which may either form a hard scale, or a soft mud, according to the slowness or rapidity of separation. The chemical equation for this change is:

$$Ca(HCO_3)_2 = \underset{\text{(insoluble)}}{CaCO_3} + H_2O + CO_2.$$

b. By adding slaked lime or lime to the water. This method yields double the amount of calcium carbonate, which occurs in method *a*, as a flocculent precipitate, but it avoids the evolution of carbonic acid gas. The chemical equation is:

$$Ca(HCO_3)_2 + Ca(OH)_2 = \underset{\text{(insoluble)}}{2CaCO_3} + 2H_2O.$$

c. By adding caustic soda to the water. This chemical combines with the second CO_2 molecule of the bicarbonate, and precipitates the calcium carbonate as before, while sodium carbonate remains insoluble. The chemical equation is as follows:

$$Ca(HCO_3)_2 + 2NaOH = CaCO_3 + Na_2CO_3 + 2H_2O.$$

2. Magnesium carbonate. Chemical symbol $MgCO_3$—always present in natural waters as bicarbonate—$Mg(HCO_3)_2$. This salt can be removed:

a. By boiling.

b. By adding slaked lime or lime water.[1]

c. By adding caustic soda.

The chemical equations are similar to those given for calcium carbonate, with the substitution of Mg for Ca in the molecular formulæ. Both calcium and magnesium carbonate are loose flocculent precipitates when first caused to separate from water by the use of lime water, but boiling renders these precipitates dense and crystalline.

3. Calcium sulphate. Chemical symbol: $CaSO_4$.

This salt can be removed from water:

a. By heating it with sodium carbonate. The chemical equation for this change is:

$$CaSO_4 + Na_2CO_3 = Na_2SO_4 + \underset{\text{(insoluble)}}{CaCO_3}$$

b. By heating with barium carbonate. This chemical produces two insoluble compounds instead of one, and the sulphate is removed from the water as barium sulphate. The chemical equation is:

$$CaSO_4 + BaCO_3 = \underset{\text{(insoluble)}}{CaCO_3} + \underset{\text{(insoluble)}}{BaSO_4}.$$

4. Magnesium sulphate. Chemical symbol $MgSO_4$.

This salt can be removed from water by heating it with sodium carbonate, or with barium carbonate. The chemical equations are as in 3 with the substitution of Mg for Ca in the molecular formulæ.

It will be observed that when sodium carbonate is the chemical used for removing sulphates calcium and magnesium carbonates are again the precipitated salts, but that an equivalent amount of sodium sulphate remains in solution. As

[1] All rights of reproduction and translation reserved. Copyright, 1906, by J. B. C. Kershaw.

[2] See abstract of paper upon "The Action of Slightly Akaline Waters upon Iron," read before the Society of Public Analysts, by Messrs. Cribb and Arnaud, *Mechanical Engineer*, London, January 13, 1906.

[1] Magnesium carbonate is converted into magnesium hydrate by treatment with lime water, and this secondary change complicates the removal of hardness in the case of magnesium salts.

before, the magnesium carbonate is converted into magnesium hydrate if excess of lime be present in solution.

The precipitated carbonates are flocculent when first separated, but become dense and crystalline on boiling. Barium carbonate on the other hand removes both the base and the acid radical of the calcium or magnesium sulphate, and for this reason would be generally employed, if cheaper and more easily applied to this purpose.

5. Magnesium chloride and magnesium nitrate. These two salts are occasionally present in natural waters in appreciable amounts. They can be decomposed in the same manner as the sulphate; namely, by heating the water into sodium carbonate. The chemical equation for the changes are as follows:

$$MgCl_2 + Na_2CO_3 = MgCO_3 + 2NaCl$$
$$Mg(NO_3)_2 + Na_2CO_3 = MgCO_3 + 2NaNO_3$$

Here again an equivalent amount of sodium chloride or nitrate remains in solution—and the change is from a dangerous salt to a less dangerous one; for magnesium sulphate, chloride and nitrate are all salts which may decompose and liberate corrosive gases, if heated to a high temperature as a scale upon boiler plate.

Magnesium carbonate is stated by some authorities to be slightly soluble in water, and they recommend that it should be converted into the insoluble hydrate, by the addition of an excess of lime water, according to the equation:

$$MgCO_3 + Ca(OH)_2 = Mg(OH)_2 + CaCO_3.$$

The solubility of the carbonate is very slight—(100 parts of cold water dissolve only 0.02 part of the carbonate) and moreover the precipitate obtained when precipitating a hot solution of magnesium sulphate with sodium carbonate, is a mixture of hydrate and carbonate, and not carbonate alone. An excess of lime, however, is required to obtain the separation of the other carbonates when magnesium is present, and its use will add to the bulk of the precipitate which remains to be dealt with in the softening apparatus. Magnesium hydrate alone is a gelatinous precipitate likely to cause stoppage of the filters attached to the softening apparatus.[1]

(3.) The Calculation of the Amount of Softening Chemicals Required—The tests upon which the additions of the softening chemicals are based are those for temporary and permanent hardness. It is not advisable to attempt to remove the temporary hardness by boiling, for long-continued boiling is required to remove the whole of this, and such an expenditure of fuel or of waste heat would not prove economical. It is in fact best to reduce the hardness to the lowest degree possible, by the use of lime and sodium or barium carbonate; and all modern water-softening plants are operated upon this basis. It is possible to remove both carbonates and sulphates by the use of caustic soda alone, when the two salts are present in molecular proportions,—for the carbonate of soda produced by the reaction with the carbonates then enters into reaction with the sulphates. The reaction in this case is expressed by the following equation:

$$Ca(HCO_3)_2 + CaSO_4 + 2NaOH = 2CaCO_3 + Na_2SO_4 + 2H_2O.$$

Carbonates and sulphates do not, however, occur often in water in molecular proportions. Caustic soda is also dearer than caustic lime.

The calculations of the necessary amount of chemicals are made from the chemical equations given in Section 2 of this article. These show that one molecule of calcium carbonate or of magnesium carbonate requires one molecule of calcium hydrate or two molecules of sodium hydrate to precipitate it; and that one molecule of calcium sulphate or magnesium sulphate requires likewise one molecule of sodium or barium carbonate for its decomposition.

The molecular weights are as follows:

Salts present in water as impurities.	$CaCO_3$	100	
	$MgCO_3$	84	
	$CaSO_4$	136	
	$MgSO_4$	120	
Softening chemicals.	CaO	56 or $Ca(OH)_2$	74
	NaOH	40 or 2 Na(OH)	80
	Na_2CO_3	106	
	$BaCO_3$	197	

Since the English degrees of temporary and permanent hardness in water are expressed in grains of calcium carbonate per gallon, and the molecular weight of this salt is just 100, the calculations are considerably simplified. It is only necessary to multiply the degrees of temporary or permanent hardness by 0.56 or by 1.06 to find the grains of lime or sodium carbonate required for each gallon of water. The further calculation is equally simple, since the result multiplied by[1] $\frac{1,000}{7,000}$ (that is divided by 7) gives the pounds avoirdupois required to soften 1,000 gallons of water. Fig. 31 is a diagram showing the pounds of softening chemicals required per 10,000 gallons of water, for the various degrees of hardness from one degree to twenty-five degrees.

For the other chemicals the method of calculation is similar, the factor for caustic soda being 0.80 and for barium carbonate 1.97, in place of those given above. It must be remembered in making these calculations, that commercial chemicals are seldom pure, and that some allowance for impurities and losses in making up the solutions must be made in the final calculations for water softening. For caustic lime, an allowance of twenty per cent is advisable; for sodium carbonate five per cent; and for caustic soda, an allowance of ten per cent.

It is, however, unnecessary to purchase high grade chemicals for softening purposes, and if a chemist be in charge of the softening plant, a considerable saving can be effected in the annual expenditure upon chemicals by purchase of low grade or damaged products from the manufacturers—at fifty per cent below the usual market prices. Thus in the manufacture of caustic soda an impure product known in the trade as "caustic bottoms" is produced which sells at less than half the price of white caustic soda, and yet contains over fifty per cent of Na_2O, as compared with seventy per cent in the standard product. Should it be desired to use caustic soda in the softening plant instead of caustic lime, this impure product is quite good enough for the purpose. Carbonate of soda is usually bought in the form of a "soda-ash"; and here again a low grade product can be bought with advantage.

(4.) The Softening Apparatus—All the well-known and patented forms of water-softening apparatus are based on the chemical reactions given in Section 3. They differ from the other simply in the mechanical arrangement of the plant, and in the devices used for rendering the apparatus automatic in its action. The best illustrated description of water softening apparatus is to be found in a paper read by Messrs. Stromeyer and Baron before the Institution of Mechanical Engineers of Great Britain in December, 1903. This paper was printed in full in

[1] The only other case in which an excess of softening chemicals is required is when the water contains silica in solution. This is a most dangerous impurity, and can only be removed by use of an excess of lime and soda.

[1] One pound avoirdupois contains 7,000 grains.

many of the technical journals of that date, and readers desiring further information upon the subject of water-softening apparatus are referred to it.

The use of secret compositions for putting into boilers, in order to prevent scale and grease troubles, is unwise and should never be practised. Apart from the excessive prices paid for such compositions, the impurities of a boiler feed water ought to be removed before the water enters the boiler, and not separated inside it. The addition of caustic soda to the water as it enters the boiler is another practice which must be condemned except when carried out under expert control; for under certain conditions this use of caustic soda does more harm than good, and also increases the tendency of the boiler to produce wet steam.

The water, therefore, must be treated with the softening chemicals in some apparatus outside the boiler plant. If a chemist be available to take charge of and control the operations, the writer considers the intermittent type of apparatus, in which the chemicals are allowed a considerable time to act in large tanks, in which the precipitates can settle by gravitation, to be the best. Any chemical engineer could design such a water-softening installation, and the payment of heavy royalty fees, or of an excessive first cost for the plant, would thus be avoided.

If no chemist be available to control the work of the plant, one of the automatic and continuous types of softening apparatus must be selected. A discussion of the comparative merits of the large number of automatic softeners now in the market would, however, lead the writer beyond the proper scope of these articles, and only two general principles for guidance in the selection can be given. In the first place the softening apparatus must be sufficiently ample in capacity to deal with the whole of the boiler feed. A softening apparatus worked beyond its rated capacity is certain to lead to dissatisfaction.

In the second place, the filtering or separating chamber of the softener must be large, efficient in action, and easy of access for cleaning. The success of a softening apparatus depends largely upon the complete separation of the precipitated carbonate of lime from the water. To allow this carbonate of lime to get into the boilers is to throw away the advantages gained by the use of chemicals. In some automatic softeners the filters and settling chamber are not satisfactory. Finally, whenever possible, the water should be passed into the softening apparatus warm or hot—*i. e.*, after it has passed through one set of economizers. Nearly all chemical reactions are accelerated by heat, and when working with little above the calculated amount of softening chemicals, the speed of reaction is of great importance to the successful operation of the plant.

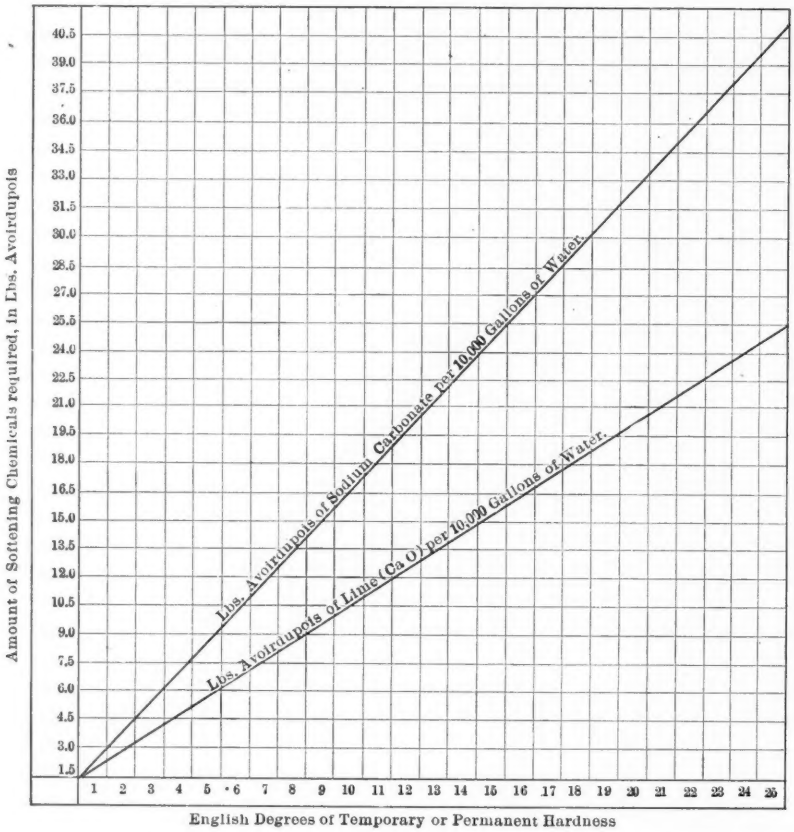


FIG. 31.—DIAGRAM FOR WATER-SOFTENING CALCULATIONS.

(NOTE—Twenty per cent has been added to the theoretical figures for lime, and five per cent to the theoretical figures for carbonate of soda.)

(5.) The Control of the Softening Process—The water sampling apparatus described in Article V of this series must be employed to check the work of the softening plant. The samples of water collected in this way ought to be tested daily by the engineer or chemist in charge of the plant.

It is advisable to have two sets of twelve or twenty-four sampling vessels in use—one set collecting hourly samples of the untreated water, and the other set collecting hourly samples of the softened water as it flows from the softening apparatus to the boilers. A selection from these samples is then made each day for the chemical examination; the general appearance of the water when examined in a tall glass cylinder (Fig. 32) and its effect upon neutral litmus paper, being used as a guide in this selection.[1] The presence of calcium or sodium hydrate in the treated water can also be detected by the use of turmeric paper, which will turn reddish brown when these chemicals are present. This effect will, of course, signify, either that an excess of lime and soda is being used in the softening plant, or that the water is being passed too rapidly through the plant, and that the

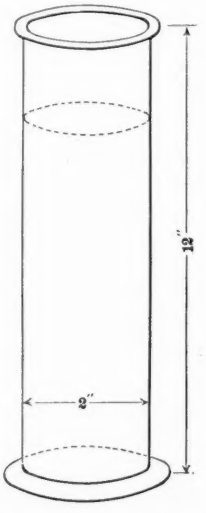


FIG. 32.—CYLINDRICAL JAR FOR EXAMINING SAMPLES OF WATER.

[1] A weak solution of silver nitrate is also of use in this preliminary examination of the water. Carbonates in solution produce a white precipitate of silver carbonate. hydrates produce a light brown precipitate of silver oxide

chemical reactions described in Section 2 have not had time to be completed. The time element is, in fact, much more important than many makers of automatic softening apparatus have realized, and it is this time factor which gives the non-continuous tank system of softening, a decided advantage.

When taking samples of water from the tanks shown in Fig. 22 (Article V) it will be necessary to thoroughly mix the water with a wooden plunger, for a sediment of calcium carbonate may be found at the bottom of each vessel, due to unsatisfactory working of the softening plant. When such a sediment is found, either the rate of flow through the softening apparatus is too rapid, or the filtering chamber is out of order, and an investigation must be made to find and remedy the fault without delay. Having selected certain samples for further examination, the temporary and permanent hardness of these must be determined by the methods described in Article VI. The difference between the tests of the untreated and treated water will show the working efficiency of the softening plant, and will also provide the necessary data for any alterations in the amount of chemicals used. Once weekly, or daily if this be possible, an average sample of the water flowing from the softening plant, is tested for total solids and for oil. As already pointed out, the use of sodium carbonate or caustic soda has the disadvantage that sodium sulphate remains in solution in the treated water; and thus the use of these chemicals will not cause any reduction in the total dissolved solids but actually increase them. The softening of a water containing ten degrees of permanent hardness, will add over ten per cent to the amount of dissolved salts in the softened water. For this reason, boilers fed with hard waters that have been softened by the use of sodium carbonate, require frequent blowing off; otherwise the sodium sulphate becomes concentrated to a dangerous extent, and attacks the boiler fittings. As regards the presence of oil, this will not often be found in the water flowing from the softening apparatus; since the precipitation of calcium carbonate in this will carry down the particles of oil. Should oil be found, however, it will be necessary to erect a special oil separator for treating the water after it flows from the softening apparatus, a separator working on the electrolytic principle being most suitable for works where electric power is generated.

Organization of the Virginia State Independent Telephone Association.

The Virginia State Independent Telephone Association was organized at Richmond, Va., on October 11. Independent companies from all parts of the state were represented, and it is announced that the association will be affiliated with the International Independent Telephone Association. The following officers were elected for the ensuing year: president, Albert Parlett, Bristol; first vice-president, F. F. Marbury, Alexandria; second vice-president, W. N. McAnge, Suffolk; secretary-treasurer, B. L. Fisher, Rocky Mount. A constitution and by-laws were adopted, and the report of the committee on credentials showed that companies operating over 10,000 telephones were represented, as follows: Capital City Telephone Company, F. F. Marbury, Alexandria; Farmers' Mutual Telephone Company, of Albemarle, T. E. Powers; Southern States Telephone Company, G. L. Hadyn, Norfolk; Bristol Telephone Company, Albert Parlett, Bristol; West Halifax Telephone Company, Mr. Ingram; Franklin County Telephone Company, B. L. Fisher, Rocky Mount; Chuckatuck Telephone Company, George W. Watts, Suffolk; Harrisonburg Mutual Telephone Company, W. C. Switzer, Harrisonburg; Nansemond Telephone Company, W. N. McAnge, Suffolk; Rockingham Mutual Telephone Company, W. C. Switzer, Harrisonburg; Floyd County Telephone Company, B. L. Fisher, Floyd Court House.

The Automobile Club Show.

The annual exhibition of the Automobile Club of America will be held in the Grand Central Palace, Lexington avenue and Forty-third street, New York city, from December 1 to December 8, 1906. Over 60,000 square feet of space has been applied for by manufacturers and exhibitors. As only 55,000 square feet is available, some of the exhibitors will be compelled to modify their demands for space.

In addition to automobiles there will be an attractive areonautical exhibition in connection with the "old show." In this exhibition everything new and novel in the balloon and air-ship line will be on exhibition. A feature of this part of the show will be Frank P. Lahm's balloon, United States, which won the recent international contest from France to the English coast, and the two balloons, Orient and Centaur, which recently engaged in a distance contest from Pittsfield, Mass.

THE LARGEST MOVABLE DAM OF THE BEARTRAP TYPE IN THE COUNTRY.

BY W. C. WEEKS.

The installation of a beartrap gate, or more properly speaking, a movable dam of the beartrap type, at the north channel controlling works of the extensive power development by the Washington Water Power Company at Post Falls, Ida., on the Spokane river, has awakened considerable interest and speculation as to the manner of its construction and operation, as well as its history and development to its present stage of perfection.

As far as is known to me the beartrap dam at Post Falls is the only one of its kind in the Inland Empire, and a brief description and history of this gate and its prototypes may be of interest to those connected with the various power development enterprises in the northwest, as well as to those who take a general interest in things out of the ordinary.

The design and construction of means for controlling the flow of water in sluices, flumes and locks has been given very close and detailed study by European engineers for many years, and it may here be noted with satisfaction that the beartrap type of movable dam is distinctly an American invention, and, strange to say, was the direct result of the necessity of obtaining a supply of anthracite coal to operate a wire mill in 1818.

No gate or dam heretofore constructed was suitable to the purpose, so Josiah White devoted his talents to constructing a movable dam which could be made to impound water in a pool, and then fold up or collapse sufficiently to allow coal barges to pass over it with the rush of water. He devised such a dam, and in order to demonstrate its practical workings had a small gate built in an experimental sluice in Mauch Chunk creek. Curious persons were evasively answered by the workmen that they were building a bear trap, and this form of dam has retained the name of "beartrap" ever since. A number of dams were built in the river, supplied with beartrap gates, and their use was so successful that they became of great importance in hydraulic development.

The first beartrap dam consisted of two flat, rectangular leaves, the leaves having a width of a certain ratio to each other, and a length equal to the width of the sluice they were to control. The total rise of the dam is limited by means of a number of chains fastened to the under side of the lower leaf, which coil up on the

bottom of the chamber when the gate is down. The successful operation of the device depends upon an unbalanced hydrostatic pressure on the leaves of the gate when the pressure of the water above the dam is admitted to the chamber beneath.

With the development of navigation in the United States came a further study of beartraps. A man of prominence, Ashbel Welch, came out boldly with his approval of the type, and we hear of a board of United States engineers recommending the adoption of the beartrap for a dam at Beattyville, on the Kentucky river, in 1886.

Naturally a number of improvements were proposed, some of which were variations, others alterations, and some having distinct merit. The development may be readily traced from the original beartrap to the design recognized as having unusual merit, that of being readily proportioned to all heights of backwater. Passing over some unimportant and grotesque modifications we come to Girard's French patent, in which the lower leaf was hinged near the middle. This was a new idea of genuine merit, but the French engineers failed to appreciate it, and it remained for Thomas Parker, of Menominee, Wis., to improve upon Girard's patent by reversing the gate, pulling the folding leaf up stream, and protecting the gate against destruction by an upstream leaf. Were it not for this leaf, débris would sooner or later jam between the upper leaves and wreck the gate.

Next we note Lang's improved gate, in which one of the leaves of the Parker gate is replaced by a tie and the upstream protecting leaf shortened. Several dams of the Parker and Lang types of beartrap have been constructed in the middle west, all of which are giving satisfaction. They find particular favor with lumbermen in the improvement of streams for driving logs, and this fact has extended their use.

Next we come to the reversed Parker, a form proposed and patented by Captain A. O. Powell, now chief engineer of the Lake Washington ship canal, and Archibald Johnson in 1896, both these gentlemen being at that time engineers in the United States engineer office at St. Paul. Several of these have been constructed and are in successful operation. It is particularly sensitive to difference in elevation of head and tail water, that installed at Lake Winnibigoshish dam to northern Minnesota rising with a head of but two inches.

The beartrap at Post Falls is of the reversed Parker type. The entire controlling works at the north channel, including the beartrap, was designed by the patentee of the reversed Parker beartrap. It was completed just before high water this spring, but because of freshly placed concrete in the foundation no attempt was made to operate the gate until the flood had partly subsided. It was then found that the gate would not rise, owing to the excessive weight upon the idler or downstream leaf. This leaf was accordingly removed, the location of this gate being such that the idler was not essential, and since that time the beartrap has worked in a satisfactory manner, responding perfectly to the operation of the controlling valves.

Though there are several larger, the beartrap at Post Falls is one of the large beartraps, and probably the largest ever constructed of its type. It closes an opening 110 feet wide and in common with the working of all dams of the beartrap type, is operated with ease by one person. This is one of the features of this class—the ease and simplicity of operation. The beartrap in the Chicago drainage canal spans an opening 160 feet wide; one was built on the Monongahela river 120 feet wide, and there are doubtless others closing passes in excess of 100 feet. The object of the beartrap at Post Falls is to provide an easily controlled opening for the passage of an immense volume of water laden with débris and drift.

By its installation provision has been made to pass, without raising the river in the least above its natural level, all the water and more, that ever came in the highest known high water. In other words, the beartrap type of movable dam, in conjunction with the Tainter gates, has enabled the controlling works at the north channel to be so constructed that the entire development of the Washington Water Power Company at Post Falls has resulted in increased facilities for the passage of flood waters over that afforded by the river in its primitive condition.

Beartrap Type, Movable Dam of the Washington Water-Power Company, Post Falls, Ida., on the Spokane River.

Economy in Electrifying.

The work of electrifying the surface plants of the Calumet & Hecla, says the New York *Sun*, which was begun about two years ago, has progressed to a point where results are becoming pleasingly evident. The new electric plant is located at Lake Linden, near the mills and smelters, and four miles from the mine, which is on the hill above, effecting a considerable saving in transportation charges on fuel, as the company burns about a thousand short tons of soft coal daily. The new power-house replaces a half-dozen or more isolated plants, all of comparatively small size, and will greatly reduce the cost of motive power in many departments of the mining and milling. The giant hoists and air-compressors of 2,000 to 8,000 horse-power each, for which this mine has been famous for many years, will use steam as before, but the hundreds of small engines will employ electricity hereafter, and it will be possible to equip the various lathes and other machines with individual motors in accordance with the most advanced shop practice.

DATA ON INDOOR ILLUMINATION.[1]

BY J. E. WOODWELL.

In approaching a problem on illumination, consideration is first given to the quantity required. This will vary in accordance with the uses to which the spaces to be illumined are to be put. It has been found, moreover, that the eye adjusts itself over a considerable range in intensity, so that between certain maximum and minimum values the artificial lighting is equally effective. The final criterion of satisfactory illumination is, therefore, not a definite intensity as expressed in foot-candles, but a visual effect or physiological sensation incapable of quantitative expression. The primary fact to which we must refer is the light sensation, and this is dependent upon the quality as well as the quantity of the light. Illumination has been defined as the light which in quantity and quality enables the outlines of objects to be discerned and colors to be perceived. It is evident, also, that the visual effect or apparent brilliancy is dependent upon the amount of light reflected from the object illuminated to the eye.

In consequence of the complex relation between the physical laws of light and the resulting physiological sensation, the quantitative measure of illumination is not to be wholly relied upon as the basis for calculation. Data taken from successful examples of indoor illumination where all of the conditions as to reflection values, etc., are known are most valuable, but, unfortunately, illuminometer tests made under such conditions that the errors to which such measurements are particularly subject are eliminated are very scarce. In the absence of actual data similarly determined for almost every variety of indoor conditions, it is necessary to approximate general values for the intensity upon the basis of judgment and experience. It is known, for example, that one foot-candle is an amount which is sufficient to enable one to read print of this size type comfortably, while for newspaper print at least two foot-candles is desirable.

In the postal service, for reading addresses of mail in an endless variety of forms of pen, pencil and print with backgrounds of various color, a local illumination of from two to four foot-candles has been found by extended experience to be required; two foot-candles is generally sufficient for desk illumination, though for work involving much detail, three and even four foot-candles has not been found excessive. For corridors, public spaces, assembly rooms, the figures range from 0.5 to 1.5 foot-candles, while in stores where dark goods are displayed or a brilliant effect is desired, five to ten foot-candles is not uncommon. The latter amount is also required for tracing, drafting, engraving and other similar work. These intensities relate to the working plane, and in addition, consideration must be given to the walls and ceiling and whatever objects in the space are to be illuminated, and the figures determined upon for this purpose will depend principally upon the color and reflection values of such surfaces.

Having determined the intensity of illumination and its general distribution in a given space, it is necessary to choose the illuminant and its accessories for diffusing and directing the light, and to decide upon the number and position of units in order to secure the predetermined result.

In order to determine what may be accomplished with a given light source it is necessary to know its distribution curve, including that of any requisite accessory. Curves of practically all illuminants and many accessories have been widely published recently, and are available to the engineer.

The distribution is generally shown on a polar diagram. Such curves are of great value to the illuminating engineer, but unless the underlying principles are kept well in mind, deductions from a comparison of such curves for lamps and reflectors of different types are apt to be misleading to the layman. To show this properly, recourse must be had to the Rosseau diagram, which is essential to a proper comparison of the performance of various reflectors.

The paper describes the usual method of determining the illumination given by a certain source and shows what allowance may be made for reflection. In practical work, the illumination received by a surface or object is frequently very materially increased by diffused reflection from walls and ceiling, the amount being dependent upon the distance of the light source from the reflecting surface and the coefficient of reflection. For interiors having dark walls or with large dimensions, the increase in illumination due to reflection is small, while under favorable conditions, such as small interiors with white plaster or painted walls and ceilings, or with white marble or similar interior finish, the direct illumination may be increased two or even three times. The theoretical constant is computed by the formula $K = \frac{1}{1-C}$ where C is given a value representing the actual coefficient of reflection of the walls or surfaces as the result of experiment or experience. For public buildings with relatively large interiors and light-tinted walls and ceilings, values of $\frac{1}{1-C}$ will be found to lie generally between 1.25 and 1.50.

In planning a system of illumination for a new building in which the color scheme for decoration has not been determined, very small allowance can safely be made for reflection, particularly in the capacity of wiring circuits. Moreover, a certain margin is required in all calculations of illumination on a theoretical basis to allow for the inevitable loss in practice occasioned by the deterioration in candle-power of the light source. If, on the other hand, the economy is a sufficient object, and the finish of the walls and ceiling of a room of moderate dimensions is planned with reference to securing the full advantage of reflection, the resultant illumination may by this means be more than doubled.

In applying the foregoing principles and factors in a given case it is necessary to fix the location of the light sources. In elaborately finished interiors the position is determined with reference to symmetry and architectural requirements. In such cases the efficiency of the system is not the prime consideration and is subordinated to the esthetic features. In certain offices and workrooms, on the other hand, where no architectural limitations are imposed, the problem may be solved with sole reference to securing the maximum illuminating result for the energy supplied. The subject may be best presented by reference to examples from actual practice in the lighting of public buildings.

In the planning of the new Young Men's Christian Association building, Washington, D. C., the illuminating requirements were first carefully studied and the position of fixture outlets and general type of fixtures and light sources, including accessories, determined. The wiring system was then planned to furnish the electric current in the right place, in the proper amount, and subject to the desired switch control. The third floor of the building is devoted principally to educational work and includes a number of classrooms, of which the room shown in Fig. 1 is typical. As the room was designed for classroom and lecture purposes, it

[1] Abstract of a paper presented before the Illuminating Engineering Society, October 12

was necessary to furnish adequate illumination for reading and writing in all parts of the room on a plane about thirty inches from the floor. Between two and three foot-candles illumination was decided upon as necessary, and on account of the blackboards located on one side of the room and the uncertainty of the color value of the remainder of the wall, it was decided not to make any allowance for reflection. A number of light sources were chosen in order to prevent shadows and to secure a fairly uniform illumination over the entire working area.

The natural selection of outlets for such a room, according to conventional methods, would be the two central outlets on the major axis of the room. This method, however, would not result in securing a uniform illumination on the working plane, and in order to bring up the results to the proper amount at the most distant points in the room, an excess illumination would be furnished under the light source. A large number of light sources would result in exceeding the minimum illumination at fewer points, and would therefore be more economical, since by this means the aggregate candle-power could be reduced. The inverse square law also applies here, as with a larger number of light sources the average distance of the source to the point illuminated is less. The arrangement of outlets shown in Fig. 1 was finally selected as the result of preliminary calculation. The actual location of the outlets as shown on the plans are slightly shifted from the theoretical requirements to make the arrangement symmetrical in the room; also in consideration of a possible future division of the room by a partition in the centre.

The light source which was selected as giving a satisfactory distribution was the Meridian lamp with frosted globe and prismatic reflector. By trial calculation the No. 2 unit was chosen, and its height from the ceiling made the minimum consistent with the required illumination on the working plane. The height of the lamp from the floor was thus made nine feet nine inches, a height which also places the light source practically out of the ordinary line of vision. The results of calculations based upon the sum of the partial illuminations from the ten Meridian lamps are shown by the illumination curves in Fig. 1, taken on a diagonal and one transverse section. In the interests of temporary economy in lighting service, the No. 1 Meridian unit, giving approximately one-half the illumination furnished by the No. 2 unit, has been installed. The practical result is an illumination which is satisfactory in distribution but insufficient in quantity. The present result is sufficiently indicative, however, that the illumination furnished by the No. 2 unit, upon which the calculations were based, would be entirely sufficient.

Ceiling clusters of Meridian units are used in the assembly room of this building. In the drafting and typewriting rooms the illumination is secured by cord drops adjustable for height and fitted with a ten-inch green porcelain cone shade with white-glazed interior surface. Both drafting and typewriting require a high intensity of illumination and entire freedom from objectionable shadows, and this result can generally be most economically and satisfactorily secured by local lights rather than by the use of fewer lighting units of high candle-power.

An entirely different solution of such a problem is presented in the illumination of the room on the fifth floor of the New York Post-office, occupied by the International Money Order Division. This room is shown in plan, Fig. 2. When the illumination of this room was planned, a system of local lighting by incandescent lamps was considered, involving 135 sixteen-candle-power lamps on cord drops, and nine eight-light clusters to provide a general illumination, thus aggregating in all 207 sixteen-candle-power lamps which, on the basis of fifty watts for each lamp, would require 10.35 kilowatts energy. It was recognized that the system would be awkward to install, inefficient in operation and unsightly in appearance. An alternative method would have been to install a smaller number of lighting units of high candle-power. Such units, if of high intrinsic brilliancy, would have to be placed near the ceiling to avoid the glare in the field of vision, and should preferably, even in this location, have diffusing globes to reduce the intensity of light entering the eye by direct reflection from the white paper in front of each clerk.

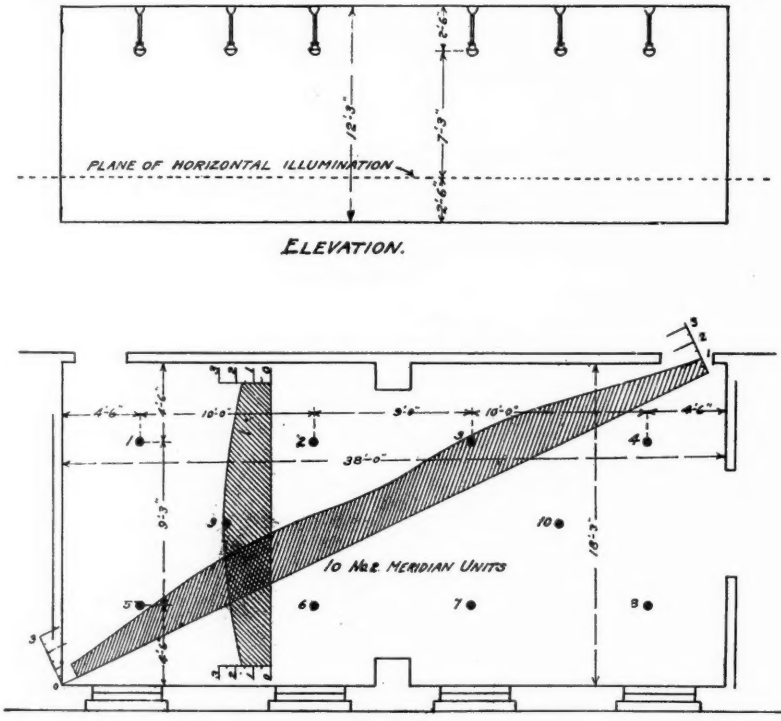


FIG. 1.—CLASSROOM, Y. M. C. A. BUILDING, WASHINGTON, D. C.

Case.	Floor Area. Square Feet.	Ceiling Height. Feet.	Cubic Contents. Cubic Feet.	Total Candle-power.	Watts Input.	Candle-power[12] per Square Feet.	Square Feet[12] per Candle-power.	Cubic Feet[12] per Candle-power.
I as installed....	3,320	25	83,000	3,192	10,784	.96	1.04	26.0
I as used.....	.....	..	.....	2,336	7,702	.70	1.42	35.5
II.....	2,340	30	72,200	3,104	10,032	1.33	.75	22.6
III.....	2,094	18⅛	38,381	1,740	6,090	.83	1.20	22.1
IV.....	7,525	19⅛	145,483	3,808	11,805	.53	1.98	38.2

[12] Mean horizontal candle-power rating.

The clerical work performed in the room apparently requires a high intensity of illumination, probably not far from three to five foot-candles of illumination normal to the desk plane. The Cooper Hewitt lamp was installed experimentally, as the color value does not affect the usefulness of the lamp for this work. The installation has been in service about ten months and has given entire satisfaction to the employés who use it. It has the advantage of an efficiency of 0.60 to 0.75 watt per candle when installed without the reflector, combined with a low intrinsic brilliancy. A test of the illumination thus secured has shown that it is nearly six foot-candles, which is probably in excess of the requirements.

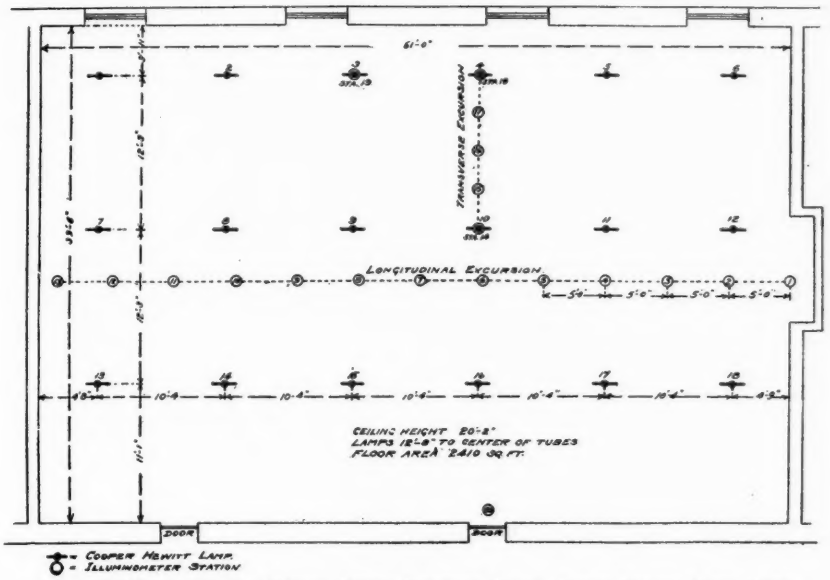


FIG. 2.—INTERNATIONAL MONEY-ORDER DIVISION ROOM, FIFTH FLOOR, NEW YORK POST-OFFICE.

Four typical examples of the lighting of public rooms, presenting as many radically different solutions of the problem of illumination, are exhibited by the following cases:

I. Courtroom, United States Court-house and Post-office, Chicago, Ill., Fig. 3.

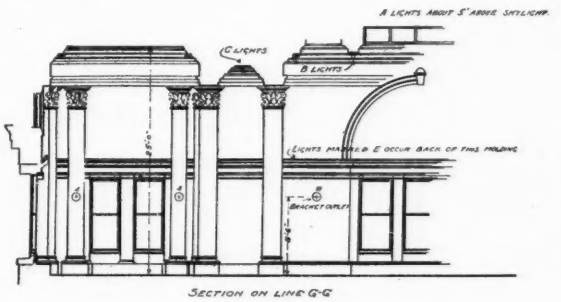
II. Courtroom, United States Court-house and Post-office, Indianapolis, Ind., Fig. 4.

III. Courtroom, Onondaga County Court-house, Syracuse, N. Y.

IV. Newspaper reading-room, Library of Congress, Washington, D. C., Fig. 5.

In order to present briefly the important characteristics of the lighting installation in a comparative way, the accompanying table has been prepared, showing such data as may prove of interest.

Case I is a room equipped with twelve four-light and four three-light fixtures over the skylight with pagoda reflectors No. 2,673 and sixteen-candle-power lamps, giving a well-diffused downward light through the ground-glass skylight; twenty-two sixteen-candle-power frosted lamps are located on two main transverse ceiling beams and fitted with pagoda reflector shades No. 2,631; thirty-six eight-candle-power frosted lamps are located on ceiling beams under skylight, without reflectors; seventy-one eight-candle-power bare lamps are installed in the cove about midway between the floor and the ceiling. These lamps are used without reflectors and produce illumination of the wall space above far from uniform. The exposed lights below the skylight beams and the cove lights are not necessary in the illumination of the room and are rarely used. The remaining illumination is secured by eight brackets, each with four eight-candle-power frosted lamps and one thirty-two-candle-power lamp in opalescent flame-tip shade, and four double brackets with twice the lamp equipment mentioned. The resultant illumination from the lamps above the skylight, studded lamps on ceiling beams and from the brackets is apparently both adequate and satisfactory. The reflection value is high, the finish being in white marble and plaster. The lighting equipment is typical of that in four similar courtrooms on the same floor.


A LIGHTS ABOUT 5' ABOVE SKYLIGHT
C LIGHTS
B LIGHTS
LIGHTS MARKED D & E OCCUR BACK OF THIS MOLDING
BRACKET OUTLET
SECTION ON LINE G-G

Case II presents a much simpler treatment. The principal illumination is here secured from sixteen brackets of special design, supporting four six-inch and one ten-inch ground-glass ball globes, the former with sixteen and the latter with thirty-two-candle-power lamps. The brackets are eleven feet above the floor, but on account of the size of the room are within the line of vision. For this reason it was necessary to use diffusing globes by means of which the intrinsic brilliancy is reduced to about one-seventh of one candle-power per square inch. The sixty-six frosted lamps of sixteen candle-power located under the skylight are used for decorative effect, and aid materially in bringing out the details of the mural dec-

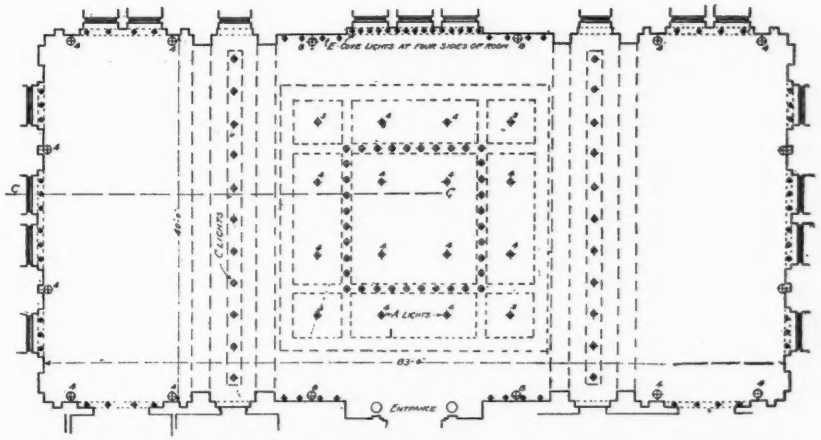


FIG. 3.—LIGHTING DIAGRAM, NORTH AND SOUTH COURTROOMS, UNITED STATES COURT-HOUSE AND POST-OFFICE, CHICAGO, ILL.

oration. The resultant effect is believed to be satisfactory and agreeable to the eye.

Case III. This courtroom is illuminated by pendant fixtures and brackets, all equipped with ground-glass ball globes cut

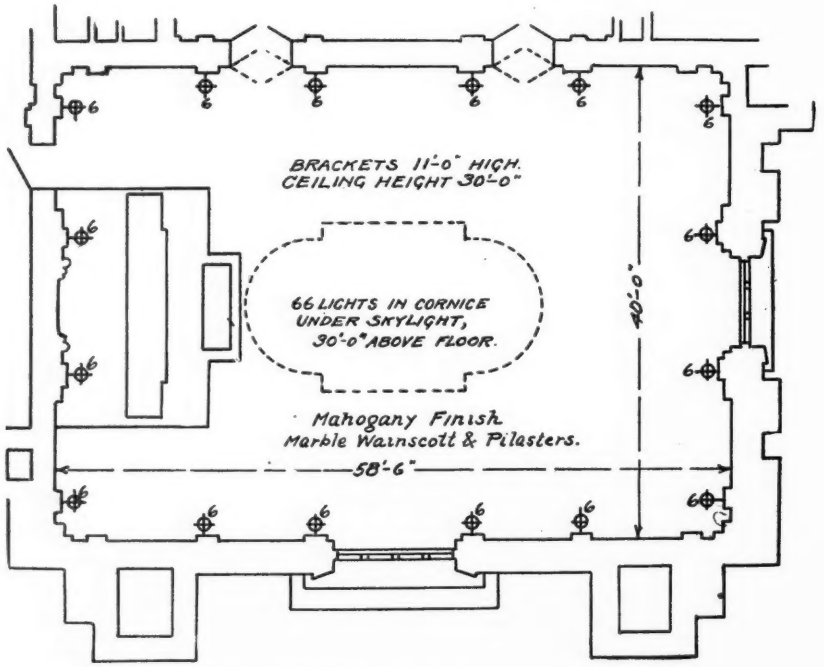


FIG. 4.—EAST COURTROOM, U. S. BUILDING, INDIANAPOLIS.

for decorative effect. The lowest point of the pendant is about twelve feet above the floor, but the intrinsic brilliancy of all light is here reduced to about one-ninth of one candle-power per square inch. The fixtures have not been placed in service yet, so that no statement of results can be made at this time.

Case IV. This room presents a somewhat different problem from that of the illumination of the courtrooms, and one much more difficult. To read newspaper print at the angle of a newspaper rack requires an illumination normal to the paper of about two foot-candles, considerably more than is secured by the present equipment according to a rough calculation, ignoring the effect of distant light. The room is 215 feet long by thirty-five feet wide, and has a lighting equipment of 238 sixteen-candle-power oval-filament lamps distributed about two feet apart on the ceiling beams, as shown in the illustration. The height of the lamps from the floor is seventeen feet. Each lamp is equipped with a pagoda reflector shade No. 2,621.

Independent of the apparent deficiency in candle-power for the requirements of the room as borne out by experience and checked by calculation, this method of illumination appears to have much to commend it. In practice, however, it is open to several objections. The length of the room is such that a very large number of lamps is brought within the field of vision at one time, and though the brilliancy of each unit is small, the effect in the aggregate is to reduce the sensibility of the eye. This effect could apparently be entirely eliminated by the use of a prismatic reflector of conical form with an opaque cardboard cover to cut off the side light. The position of the lamps, however, is not favorable with reference to the natural

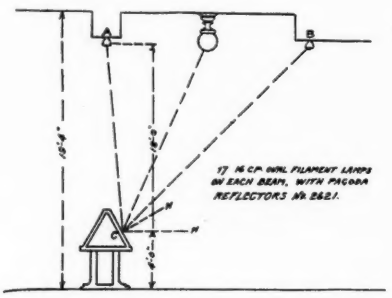


FIG. 5.—POSITION OF LAMPS, NEWSPAPER ROOM; LIBRARY OF CONGRESS.

location of the newspaper racks opposite piers, as shown in Fig. 5. The light rays from lamps on beam A strike the paper at a very oblique angle, while the reader casts an objectionable shadow produced by the lamps at B. One solution of such a problem would be to provide four fixtures in each of the fifteen ceiling panels, consisting of a thirteen or fourteen-inch ground-glass ball globe with single lamp of 75 or 100 candle-power mounted in a suitable holder close to the ceiling. By placing a prismatic reflector above the lamp inside the ball globe the required distribution of illumination is secured with good diffusion and low intrinsic brilliancy. The intensity of the light regularly reflected is also advantageously reduced.

Too much emphasis can not be placed upon the necessity of reducing the intrinsic brilliancy of an incandescent electric lamp, and the advantages of using diffusing globes of the type described is usually more than sufficient to offset the losses due to absorption. Moreover, the use of a large, well-ventilated outer globe of ground glass presenting ample radiating surface does not seriously reduce the life of the lamp, as has been shown to result from frosting the lamp globe itself.

Electrical Manufacture of Steel.

Consul Urbain J. Ledoux reports from Prague that Austrian papers are discussing the introduction of the Kjellin process in the manufacture of steel by the Poldihütte, at Kladno, Bohemia, in concert with the Oberschlesische Eisenindustrie-Gesellschaft, which process, says the Prague *Tagblatt,* may bring about a complete revolution in the Austrian steel industry. Continuing, the Prague *Tagblatt* says:

That such steps may be leading to vastly important results may easily be realized when it is considered that the Kjellin process yields an excellent steel, said to be fully equal to the best crucible steel, while the cost of production is considerably lower than with the mode of production so far in use. The Kjellin product, however, apart from its lower cost, is further praised for its ductility, density, homogeneousness, softness, the possibility of obtaining high degrees of carboniferous quality, and, finally, for its excellent magnetic properties. If these surmises—as appears highly probable —should be proved by facts, all undertakings which have at their disposition the primary requisite for the adaptation of the electric process, *viz.,* cheap electric power by means of sufficiently strong water power, will secure a great advantage over other works. Chief Engineer V. Engelhardt, in his work on the Kjellin process, states that it can compete with the Siemens-Martin method, where the kilowatt hour can be put down at about a half cent.

Electrification of the West Jersey & Seashore Railroad—I.

New System Put in Operation on an Important Branch of the Pennsylvania Railroad—Description of Power-House and Substations.

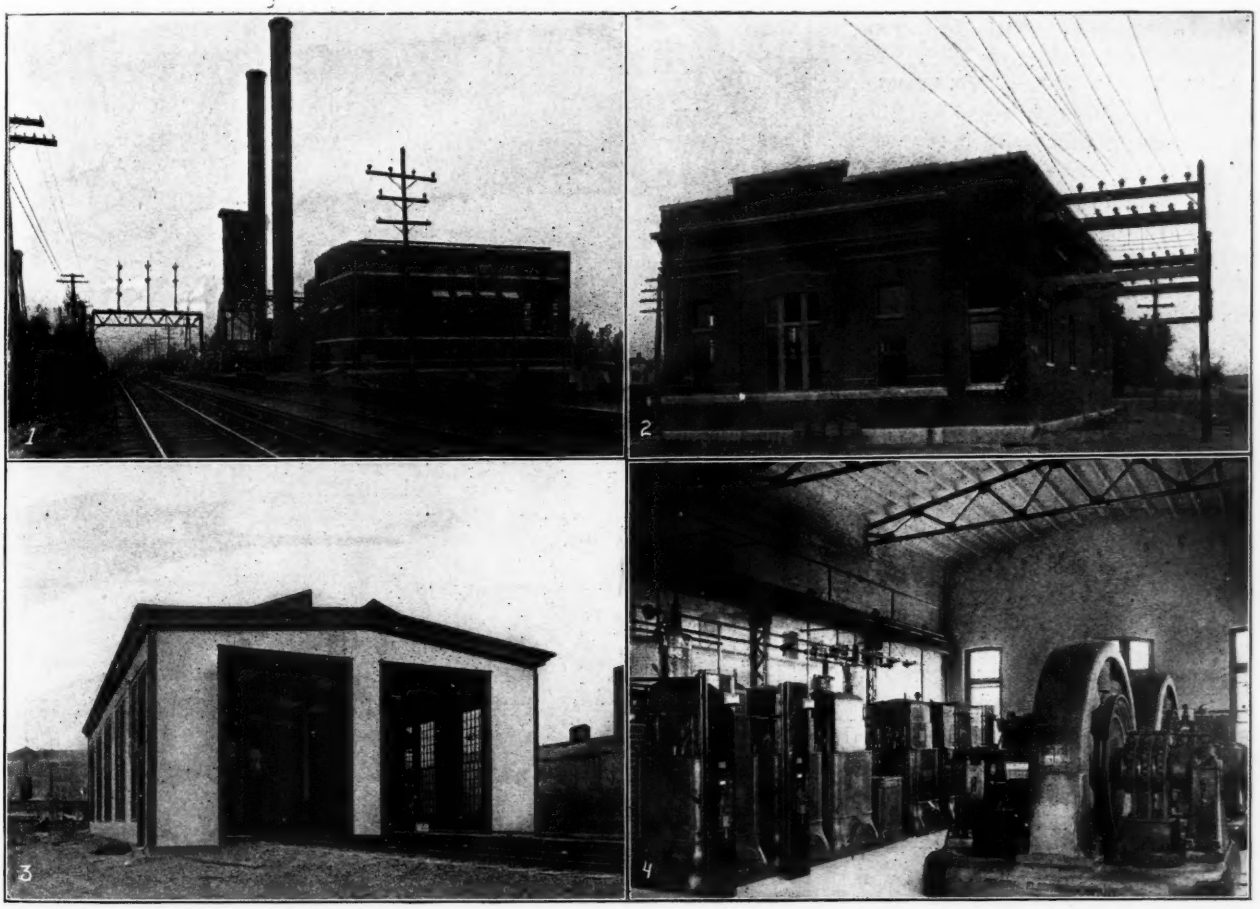
THE Pennsylvania Railroad has equipped for electric operation its West Jersey & Seashore branch, involving the electrification of a main line double track steam road from terminal to terminal of a greater length than any electrified steam road in the country.

This undertaking also involved the construction of a power-house of original design and built in record time. The site for it was chosen on January 17, 1906; the first pile was driven two days later, and on July 1, the first train to take current from the power-house was run on the newly electrified tracks. On September 18, the line was placed in operation.

The line of the electrified system extends from Camden, New Jersey, *via* Newfield, to Atlantic City, a distance of sixty-five miles, and from Newfield to Millville, a distance of ten miles. In addition to the erection of a power-house, this work has called for the building of eight substations, one of which is in the power-house, the electrical equipment of approximately 150 miles of single track, the building of seventy-one miles of duplicate high tension transmission line, and the construction and electrical equipment of sixty-eight cars. In addition, a great deal of other work always incident to extensive undertakings of this nature was done, including the laying of new rails, installation of signals, telegraph and telephone system, building of bridges and fencing and improving the stations.

The extent of the new system is shown on the accompanying map. Beginning at the Camden end of the line, an entirely new terminal has been constructed which adjoins the present ferry terminal. The work at this point includes a number of stub end tracks with suitable sheltered platforms between them, and three-quarters of a mile of new elevated double track trestle, with stone piers and steel superstructure at street intersections, has been built to connect this terminal with the existing lines, at grade, at a point near Haddon avenue.

From a point about two miles from Atlantic City, a new right of way has been secured, and after crossing the Thoroughfare on a new drawbridge the tracks cross the Philadelphia & Reading on an elevated structure and enter the new Atlantic City terminal on a descending grade. This terminal, like that at Camden, consists of a number of stub end tracks with concrete platforms between them, with steel umbrella shelters. It is located on the south of the present steam road terminal. From Camden to At-



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD. 1—POWER-HOUSE, WESTVILLE, N. J. 2—SUBSTATION, GLASSBORO, N. J. 3—CAR INSPECTION BARN, ATLANTIC CITY, N. J. 4—SUBSTATION, ATLANTIC CITY, N. J.

lantic City the road has been electrified with a third rail, with the exception of a stretch of track 4.4 miles in length between Haddon avenue and South Gloucester, the track passing through the city streets at grade between these points being equipped with the overhead trolley.

In addition to this through route, the line from Newfield to Millville—ten miles—has been electrified. On this portion of the road the overhead trolley has been installed. New terminal facilities have been provided here, including 100 feet of umbrella shelter sheds.

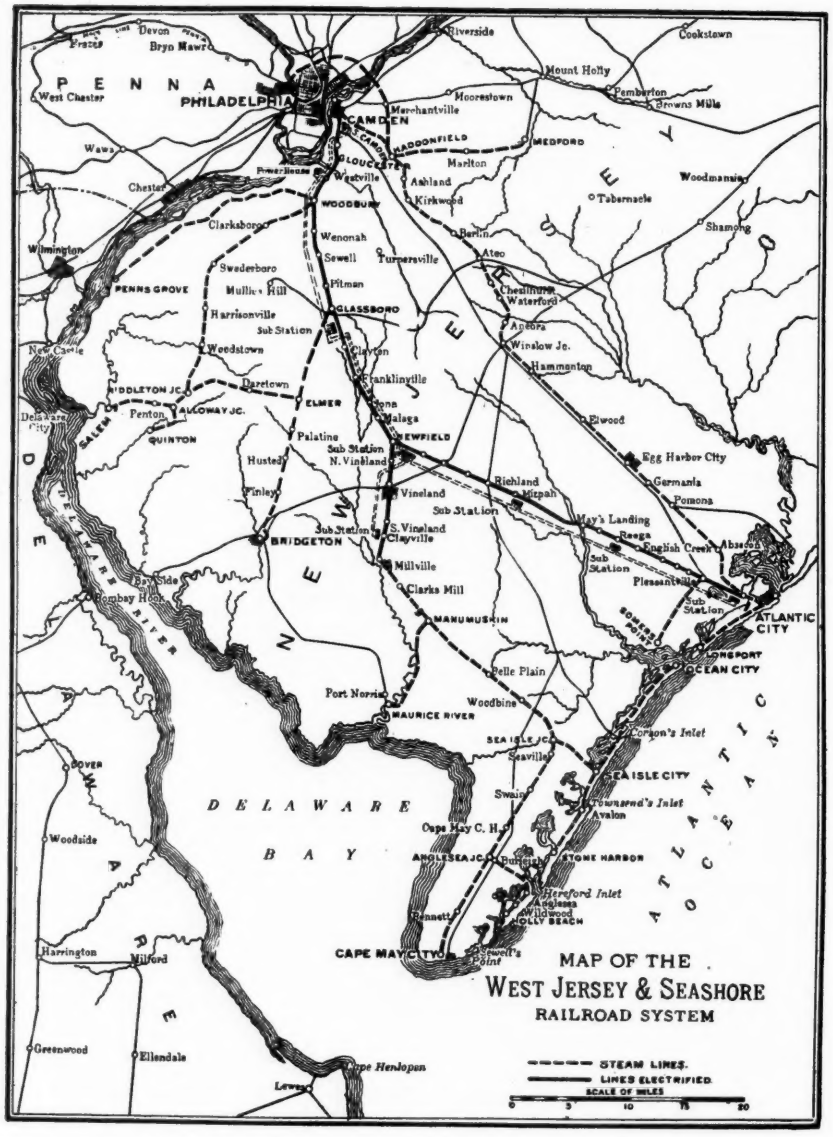
The line from Camden to Atlantic City is a double track road throughout, and is a three track road between Camden and Woodbury. From the Camden terminal to Newfield the road is laid with 100-pound rails, and from Newfield to Atlantic City it is laid with eighty-five-pound rails. The line from Newfield to Millville is a single track road and is laid with 100-pound rails.

It will be noticed on the map that the Pennsylvania Railroad Company has two roads connecting Camden with Atlantic City, and it is the longer of these routes that has been electrified. This has been done because there is a large coal traffic on the longer route that can be handled more economically and expeditiously by electric traction than is possible with steam haulage.

The importance of the undertaking is further emphasized by the density of the traffic on the electrified section of the road. The power-house and substation equipment and the line are laid out with a view of supplying sufficient power for the operation of all the cars now provided, operating in an express service to Atlantic City, and for a local service of two-car trains between Camden and Millville on half-hour intervals, and single cars between Camden and Woodbury on ten-minute intervals. The express service provided for is three-car trains running on a headway of fifteen minutes in each direction at a speed on straight level track of sixty miles per hour. The initial schedule that has been put into service includes three-car express trains between Camden and Atlantic City on one hour intervals, the running time being ninety minutes, and a local service of two, three and four-car trains run on a minimum interval of fifteen minutes during the rush hours between Camden and Glassboro, every fourth train going on to Millville. The motor, baggage and mail cars are attached to the passenger trains as conditions require. Each car in the electric service is a motor car, no trailers being used.

The contract for the entire electrification work was given to the General Electric Company, Schenectady, N. Y., and through them certain portions were sublet. The electrical equipment throughout is of standard General Electric design.

The general scheme of electrification consists of generating alternating-current power at a potential of 6,600 volts at the power-house, where it is stepped up to 33,000 volts. At the latter pressure it is transmitted over the high-tension transmission lines to the substations, where it is reduced to a potential of 430 volts by means of step-down transformers, and then led to the rotaries and converted to direct current at 650 volts, at which pressure it is fed to the third rail for operating the cars.



MAP OF THE WEST JERSEY & SEASHORE RAILROAD SYSTEM.

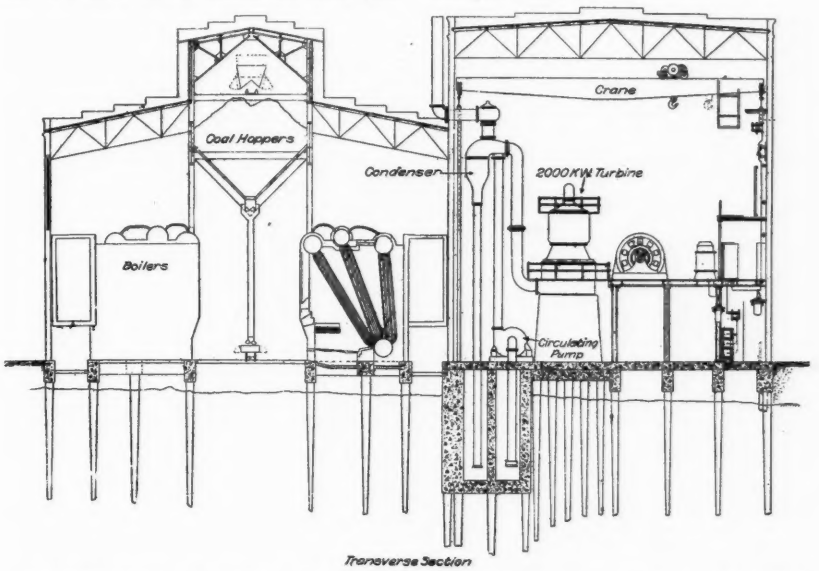
THE POWER-HOUSE.

The power-house is situated at Big Timber Creek, just to the north of Westville, N. J., at a point 5.6 miles from the Camden terminal, where there is an abundance of water for boiler feed and condensing purposes. The power-house, boiler house and stacks are built on approximately 650 concrete piles. The foundations, which were started on March 15, are of reenforced concrete and are superimposed upon the piles in such a manner that the latter project about one foot into the mass of concrete.

The boiler foundations were completed by March 25, and those for the steam turbines by June 5. The erection of the steel work for the main building was begun on April 18. On March 5 the foundations for the stacks were started and these were completed by the twenty-fifth of the same

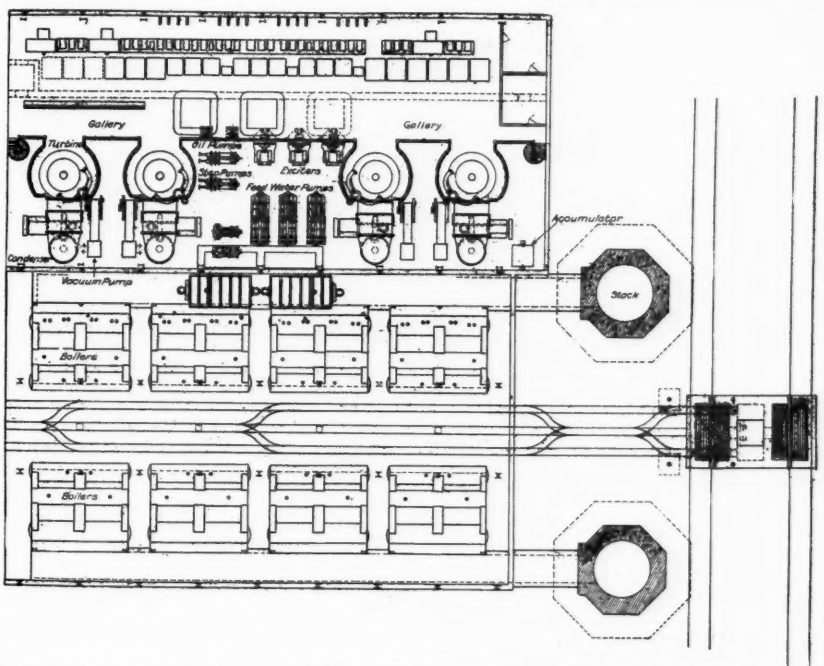
month. The steel work for the stacks was started on April 11, and the first stack was erected, lined and ready for use by June 29.

On July 1, five and one-half months from the date upon which the first pile



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—TRANSVERSE SECTION OF POWER-HOUSE, WESTVILLE, N. J.

was driven, two boilers were under steam at working pressure, a turbine and all the necessary auxiliaries were running, the substation in the power-house was in



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—PLAN OF POWER-HOUSE, WESTVILLE, N. J.

operation, and the first car to take current from the power-house was run on the line.

The main portion of the electrical equipment of the power-house is given in the following list: Three 2,000-kilowatt, 6,600-volt, twenty-five-cycle, three-phase Curtis turbo-generators; two seventy-five-kilowatt 125-volt Curtis turbo-exciters; nine 700-kilowatt, twenty-five cycle, air blast transformers, and three blowers, capacity of each, 20,000 cubic feet per minute.

The switchboard consists of: three three-phase generator panels, two exciter panels, three blower motor panels, one synchronizing equipment, three 33,000-volt transformer panels, two sets of lightning arresters and switches, six static potential indicators, and two 33,000-volt outgoing line panels.

It will be seen from the above that the present normal capacity of the generating station is 6,000 kilowatts. However, there is sufficient room provided in the layout of the building for an additional 2,000-kilowatt turbo-generator set together with the necessary auxiliaries. The foundation for the extra turbine is already built. In addition to this provision for extra power, one of the end walls of the station is of a temporary nature in order that increasing demands for power may be met with a minimum of expenditure in the future.

The most important items among the auxiliaries are as follows: Two exciter sets, consisting of horizontal Curtis steam turbines coupled to seventy-five-kilowatt, four-pole, direct-current generators running at 2,400 revolutions per minute, and delivering 600 amperes each at 125 volts pressure. The turbines of these sets work non-condensing, as the exhaust is used for heating the feed water.

Three barometric condensers, built by Williamson Brothers, in connection with Cramp & Company, of Philadelphia, who are also the subcontractors for the circulating and air pumps. These condensers are capable of maintaining a vacuum of twenty-eight inches and are designed to condense 60,000 pounds of steam per hour with circulating water at a temperature of seventy degrees Fahrenheit. The approximate ratio of condensing water to steam condensed is seventy-five to one.

Three dry air pumps built by the I. P. Morris Company, of sufficient capacity to fulfill the guarantees given with the condensers.

Three centrifugal circulating pumps built by the I. P. Morris Company, and driven by Reeves engines. The piping for these engines is so arranged that the exhaust may be discharged to either the feed-water heater or to the third stage of the turbines, the latter arrangement only being used when the exhaust from the other auxiliaries exceeds that required for the feed-water heater.

Two Cochrane feed-water heaters. Each heater has a capacity for heating 135,000 pounds of water per hour from seventy degrees Fahrenheit to 212 degrees Fahrenheit.

Two Worthington boiler-feed pumps, two Worthington make-up pumps, two Worthington step-bearing pumps, three Worthington step-bearing water-return pumps.

One accumulator for the step bearings with a capacity of 100 gallons of water at 800 pounds pressure per square inch. This accumulator was supplied by R. D. Wood & Company, of Philadelphia, Pa.

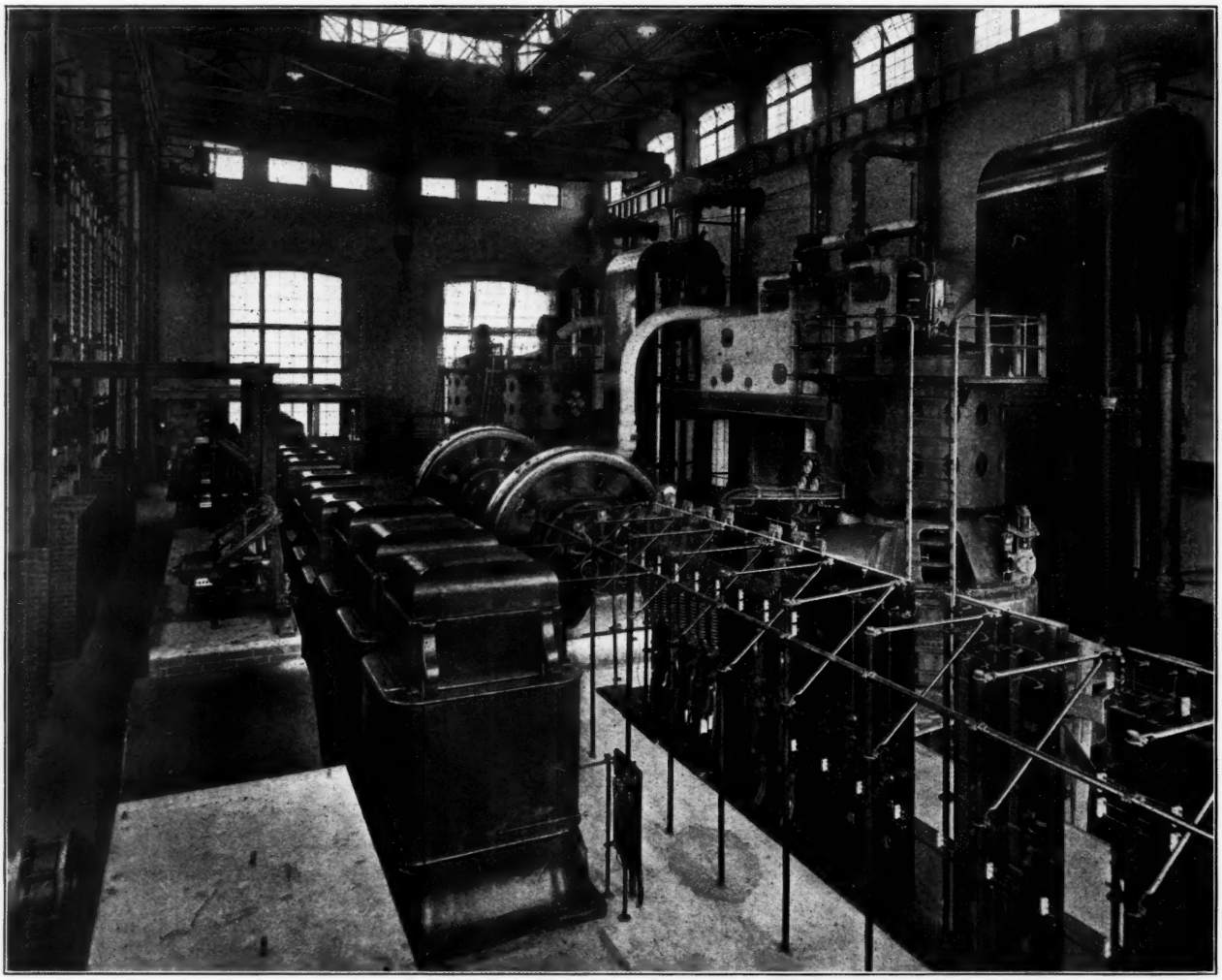
The area of the power-house is 17,069

square feet, and the cubic contents amounts to 829,113 cubic feet, thus giving 2.13 square feet and 103.6 cubic feet per kilowatt as the unit output of the station, based on 8,000 kilowatts as the ultimate capacity of the present structure.

The layout of the steam piping in the power-house is of a neat design and allows ample operating space around all the machinery. W. K. Mitchell & Company, of Philadelphia, were the subcontractors for this work together with the steam valves, etc., and Keasby & Mattison furnished the pipe covering.

The boiler house is furnished with twelve Stirling water-tube boilers arranged in pairs forming six batteries. Each boiler is rated at 358 horse-power and is furnished with a superheater capable of delivering steam at 175 pounds pressure and at a temperature of 125 degrees Fahrenheit in excess of that of the saturated steam. The Stirling Boiler Company, of Barberton, Ohio, were subcontractors for both the boiler and boiler settings.

The coal and ash handling machinery is very complete. The coal is dumped from the railway cars into a receiving hopper over which the siding rails are laid. This hopper has a slanting bottom to feed the coal by gravity through a valve which is only opened when the skip is in the correct position for loading. The loaded skip is raised by means of the hoisting engine till it reaches the level of a deflector, when it is automatically tipped into a crushing hopper, the smaller coal passing through a screen and the larger coal being broken in the crusher in transit. From this hopper the coal is fed into a gravity return car by means of the valve at the bottom, when it is conveyed by the automatic railway over the coal bunkers into which it is tipped. From these bunkers it is fed to coal cars on the tracks on the boiler-room floor. The ashes are taken from the boiler house in cars and dumped into the receiving hopper, from where they are raised in a similar manner to the coal, but the deflector is thrown in the reverse direction from that used when handling coal. The ashes are conveyed from the ash chute to an ash storage bin placed above the siding, from whence they are conveyed by means of a chute to cars on the railway track.



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—INTERIOR OF POWER-HOUSE, WESTVILLE, N. J.

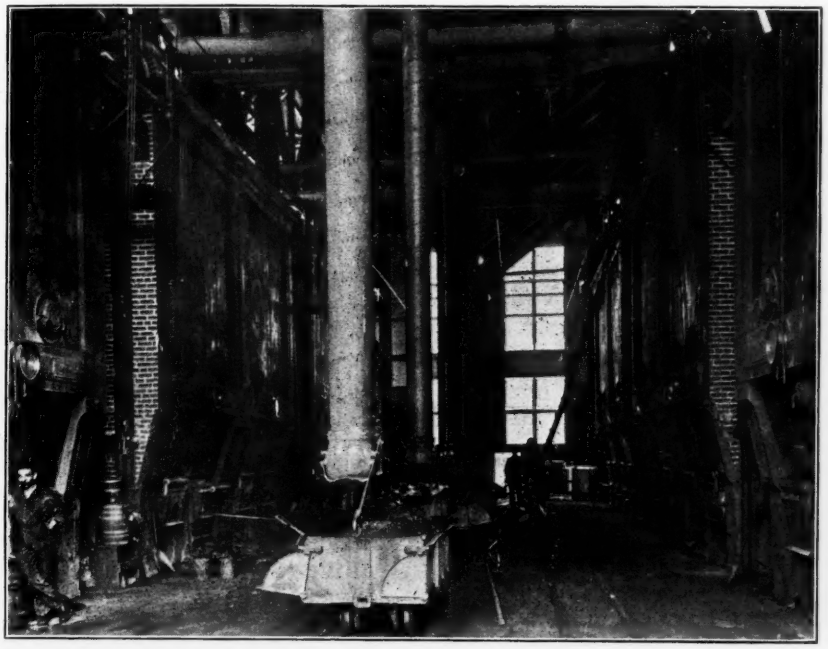
SUBSTATIONS.

The high-tension three-phase current is reduced in pressure and converted to direct current at 650 volts in eight substations distributed along the line as follows:

One is located in the power-house at Westville; three terminal substations are situated respectively at South Camden, Clayville and Atlantic City, and four intermediate stations, one at Glassboro, one

at Mizpah, one at Newfield, and one at Reega.

The equipments in the several different substations vary according to the require-



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—BOILER ROOM, WESTFIELD, N. J.

ments of the portion of the road they supply. The South Camden, Westville, Glassboro, Newfield, and Reega stations have each two 750-kilowatt rotaries installed and provision is made for an additional one. The Clayville and Mizpah stations have each two 500-kilowatt rotaries installed with provision for an additional unit of 750 kilowatts and the Atlantic City station has two 750-kilowatt rotaries now in place with provision for two 1,000 units in addition.

The rotary converters are all of standard design, and are capable of running at fifty per cent overload for two hours with a temperature rise not exceeding fifty-five degrees. The transformers are all supplied with taps giving one-third and two-thirds of the working voltage to enable the converters to be started from the alternating-current side. This method of starting needs no synchronizing and should the direct-current polarity of the machine chance to come in the wrong direction it is readily changed by means of the field reversing switch provided for this purpose. By this method, any of the rotary converters can be started, run up to full speed, and be delivering power to the line within a minute.

Three air-cooled transformers of standard design are provided for operation in conjunction with each rotary, and these are located in each case with a view to the further extension of the substation.

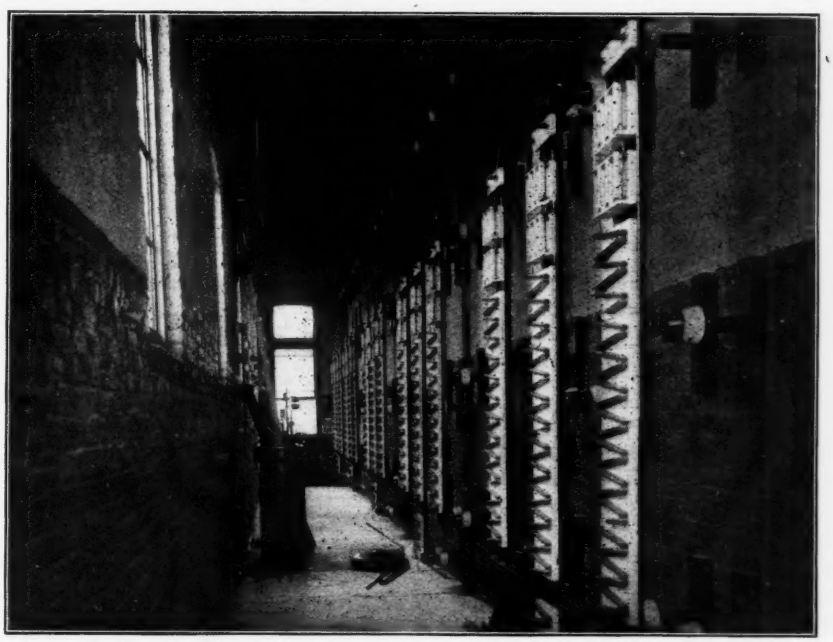
The disconnecting switches and lightning arresters in each substation are located in a separate room. The high-tension circuits are of bare copper wires supported on insulators on a pipe framework, and each pole of the oil switches is enclosed in a separate brick compartment. In the arrangement of the machinery every precaution has been taken to provide for the continuous operation of the road under all traffic and weather conditions.

The substation buildings are of red brick, trimmed with Indiana limestone facings, and the floors are of concrete. Each substation is furnished with a hand-operated crane, capable of handling any of the machinery installed.

It is a matter of interest that the substation buildings, including the foundations, were built in sixty working days, and that the installation of machinery was accomplished in thirty working days. The subcontractor for the substation buildings was Lynch Brothers, of Philadelphia.

INSPECTION SHEDS.

Inspection sheds have been built at the three terminals. The largest one is on the dock at Camden, just back of the new passenger terminal. This is a three-track shed 221 feet long by fifty-six feet wide, accommodating nine cars with room for office, storeroom and small machine shop at the end opposite to the entrance. All tracks have pits provided with steam heating, electric lights and compressed air outlets for cleaning. The third rail is not carried into the shed, overhead trolley being used instead. The centre track has an overhead hand-operated crane, with a runway extending into the machine shop. The building is of wood frame construction covered with corrugated galvanized iron, with four-ply slag roof and is sup-



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—LIGHTNING-ARRESTER ROOM, WESTFIELD, N. J.

plied with large windows and skylights. Kinnear steel rolling doors are used at the main entrance.

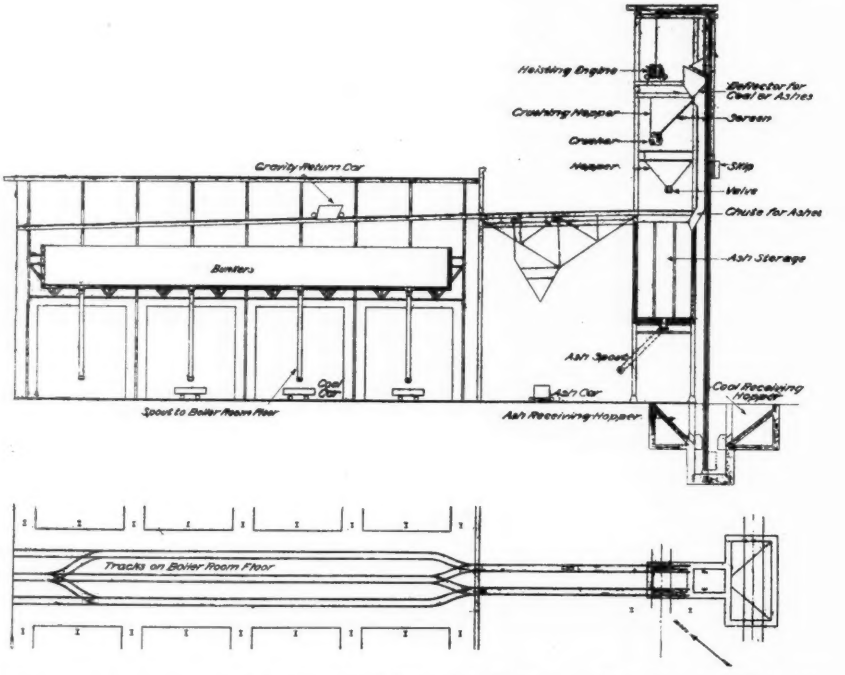
At Atlantic City the shed is of the same

general arrangement, but smaller. It is a two-track shed eighty feet by forty-two feet, with doors at both ends, and so located that a train can be run through on either track and the cars inspected one at a time as they stand over the pits in the shed. This building is of wood frame covered on the outside with expanded metal plastered with cement.

The shed at Millville has one track and is of sufficient length for one car with space to work around a truck when run out at one end. The construction is generally similar to the shed at Atlantic City.

In all of the sheds the track rail is carried on a stringer which makes the top of the rail twelve inches above the floor level. All tracks in the sheds are provided with continuous pits three feet five inches deep from top of rail. This arrangement is laid out with special reference to the arrangement of control and brake apparatus on the underside of the car, and is very convenient for inspection.

(To be concluded.)



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—COAL AND ASH HANDLING MACHINERY.

The 1907 Question Box of the National Electric Light Association.

Paul Lüpke, editor of the question box of the National Electric Light Association for 1907, has hit upon a unique scheme for keeping before the members of the association the utility of the question box. A manilla folder has been issued, containing space for any questions which may from time to time occur to the busy man. These are to be jotted down and, in time, returned to the editor of the question box.

Convention of the American Street and Interurban Railway Claim Agents' Association.

The third annual meeting of the American Association of Street and Interurban Railway Claim Agents was called to order Monday, October 15, at 2 P.M., by President S. L. Rhoades, Philadelphia.

B. B. Davis, claim agent, Columbus Railway and Light Company, welcomed the association.

John I. Beggs, vice-president of the parent association, was introduced and addressed the meeting briefly.

The Hon. W. Caryl Ely, president of the parent association, spoke upon the work of reorganization and congratulated the claim agents upon the results which had been achieved.

The report of the executive committee was read and approved.

The secretary's report showed receipts of $800 and expenses of $766.76. The association now has 201 members.

The Tuesday morning session was called to order by the president at 10 o'clock. The first business was the reading of the paper by A. J. Farrell, claim agent, International Railway Company, Buffalo, N. Y., entitled, "Which Is the Better Policy, Quick or Delayed Settlement?" This paper was discussed at length, and the paper entitled "The Policy of the Claim Department Toward the Public," was presented by W. F. Weh, claim agent, Cleveland Electric Railway Company.

At the afternoon session the question box was taken up and after this was disposed of a paper was read by C. Willis Hare, of the United Gas Improvement Company, Philadelphia, entitled, "The Claim Agent's Work of the Future." This was followed by a paper by William De-Milt Hooper, entitled, "The Relation of Statistical Bureaus to the Claim Agent's Work."

On Wednesday afternoon the association met at 1 o'clock. H. C. Bradley, adjuster of the Chicago Union Traction Company, presented his paper, entitled "Methods of Management of the Claim Department."

Resolutions of regret at the death of Mr. Feeney were passed.

The following officers were then elected:

President—S. L. Rhoades, Philadelphia Rapid Transit Company.

First vice-president—Henry C. Bradley, Chicago Union Traction Company.

Second vice-president—Andrew J. Farrell, International Railway Company, Buffalo.

Third vice-president—W. F. Weh, Cleveland Electric Railway Company.

Secretary and treasurer—B. B. Davis, Columbus Railway and Light Company.

The convention was then adjourned.

Convention of the American Street and Interurban Railway Accountants' Association.

The tenth regular meeting of the American Street and Interurban Railway Accountants' Association was called to order by President W. B. Brockway at 10.20 o'clock Tuesday morning, October 16. P. V. Burington, auditor of the Columbus Railway and Light Company, extended the hospitality of Columbus to the convention in a brief address of welcome.

The Hon. W. Caryl Ely, president of the parent organization, addressed the convention at some length, dwelling particularly upon the subject of depreciation and endorsing the action of the executive committee in placing this subject upon the programme.

The annual address was then delivered by President Brockway.

Upon motion, H. C. Mackay, one of the ex-presidents of the association, was elected an honorary member in recognition of his long and faithful services in the interest of the association.

The report of the executive committee was then read.

The report of the secretary and treasurer showed the membership to be 263 at the present time, as compared with 152 last year. The receipts for the current year amounted to $1,522.13, and the balance on hand at the present time is $485.80.

Committees were appointed and the meeting then adjourned.

At the afternoon session, which was called to order by President Brockway at 2.20 o'clock, H. M. Edwards, auditor of the New York Edison Company, and chairman of the committee on "Electric Light Accounting" of the National Electric Light Association, was introduced and stated that he came to the convention rep-

resenting that association in search of information.

C. L. Judson, of the New York State Board of Railroad Commissioners, addressed the convention briefly.

P. S. Young, controller of the Public Service Corporation of New Jersey, read his paper entitled "The Accounting of Capital Expenditures."

H. H. Adams, president of the Engineering Association, addressed the convention briefly, and acknowledged the valuable assistance rendered by President Brockway in bringing about the co-operation of the engineering branch in the reorganization of the different associations.

The question box was then taken up and the nineteen questions therein contained discussed.

At the Wednesday afternoon session the paper entitled "The Use of Curves and Statistics", was presented by A. Stuart Pratt, general auditor and treasurer of the Stone & Webster Company, of Boston.

The report of the Committee of Standard Classification of Accounts was read by W. F. Ham, chairman.

The report of the committee appointed to attend the convention of the National Association of Railroad Commissioners, held at Washington, D. C., April 2-5, 1906, was also read.

The following officers were then elected:

President—C. L. S. Tingley, Philadelphia.

First vice-president—J. H. Neal, Boston.

Second vice-president—E. F. Bryant, Bridgeport, Conn.

Third vice-president—C. L. Wight, Des Moines.

Secretary and treasurer—Elmer M. White, Birmingham, Ala.

Executive committee—W. B. Brockway, Yonkers, N. Y.; H. T. Bunn, Knoxville, Tenn.; A. Stuart Pratt, Boston; H. S. Swift, Toledo.

The convention was then adjourned.

The September Earnings of the Manila Electric Railroad and Lighting Corporation.

The earnings of the Manila Electric Railroad and Lighting Corporation for September are reported from Manila by J. G. White & Company, operating managers, as follows: Railway department—gross earnings, $37,500; net earnings, $14,100. Lighting department—gross earnings, $34,000; net earnings, $19,500. Total gross earnings, $71,500; total net earnings, $33,600.

The gradual increase in the ratio of net to gross earnings in the lighting department is a favorable feature. In six months this has been raised from fifty-one per cent to fifty-seven per cent through improved administration and the elimination of the old plant of La Electricista, the former lighting company.

Electric Developments in North Carolina.

The biggest deal in hydroelectricity ever consummated in the South, and one of the largest in the entire country, has recently been closed at Charlotte, N. C., with the agreement of the Southern Power Company to supply the well-known Cannon Mills, of Concord, with 5,000 electrical horse-power. Of this amount, 4,500 horse-power will be furnished the early part of next year and the remainder as demanded by the officials of the mills. In addition to this, the Odell mills of the same town have contracted with the Southern Power Company for 1,800 electrical horse-power which in itself is a magnificent contract. By the first of January, 1907, the power company expects to sell to lesser manufacturing enterprises an additional 1,000 horse-power, making a total approximating 8,000 electrical horse-power.

The amount of capital which will change hands under this contract aggregates a considerable sum. The outlay will figure between $125,000 and $150,000, the cost of the power furnished the Cannon Mills alone figuring within the range of $75,000 and $100,000.

The Southern Power Company is a corporation chartered under the laws of the State of New Jersey, with a capital stock of $7,500,000, authorized. The company owns 110 miles of water-rights along the Catawba river, fifteen miles from Charlotte, and holds under its control practically every power site on the water-course. There are eight of these in Piedmont Carolina.

The developments now in progress at Great Falls are well under way. When completed the power generated at that point will be transmitted to the station at Rock Hill and from there to Charlotte, Gastonia and other important manufacturing centres where the company has placed electrical power. The new contracts will call for the extension of the present transmission line to Charlotte to Concord, a distance of about eighteen miles. The cost of the new transmission line will reach $10,000 per mile. Concord is one of the most thriving of the several towns in this section. It is situated on the main line of the Southern and has a population of about 12,000. There are eight cotton mills in and around the city. J. W. Cannon is owner and operator of the following mills, which are among the largest in the Piedmont section of the South: the Cabarrus Cotton Mills, capital, $150,000; the Cannon Manufacturing Company, capital, $200,000; Franklin Cotton Mill, Gibson Manufacturing Company, capital, $375,000; Patterson Manufacturing Company, capital, $165,000.

The 5,000 electrical horse-power will be used in operating 3,511 looms and 118,436 spindles. At an early date the transmission lines will be extended to Statesville, where the company has recently closed a contract with the board of aldermen of that town to furnish 2,000 electrical horse-power. The company is spreading its lines in all directions from this point, and at an early date it is assured that practically every town of any size in the Piedmont section will be furnished with their power. It means a forging to the front of the varied industries of this great commercial centre. J. S. M.

Charlotte, N. C., October 30.

The Vaudeville Performance During Street Railway Week at Columbus, Ohio.

The vaudeville performance given at the Southern Theatre to the delegates to the American Street and Interurban Railway Manufacturers' Association and their guests was a decided success, a brilliant programme being presented.

The Third Rail Glee Club, composed of nearly fifty gentlemen of Columbus, was the opening number and was received with great applause.

The glee club was followed by Al Havens, of the Ohio Brass Company, in feats of legerdemain.

He was followed by R. M. Campbell, of the same company, who was styled on the programme as "The King of Black Face, with Apologies to Lew Dockstader." The audience demanded numerous encores.

Burton Holmes's monologue, "Behind a Curtain," was rendered by Mrs. Amory, of New York.

John Thomas was eminently pleasing in baritone solos, particularly that entitled "My Dear Old Pipe."

Thomas H. Bibber, of the American Circular Loom Company, was in fine fettle and kept the audience in a roar with stories hitting the various officers and members of the association. Mr. Bibber also rendered a number of up-to-date parodies, which were well received.

A comedietta entitled "A Game of Cards," was delightfully acted by E. J. Wendell, D. W. Dennett and Francis M. Verdi.

The hit of the evening was probably made by Clarence E. Billings, of the Colonial Steel Company, in a sketch entitled "An Inter-Reuben Trip from Portland, Me., to Columbus, Ohio."

The performance closed with selections by the Columbus Serenaders.

American Institute of Electrical Engineers.

The two hundred and tenth meeting of the American Institute of Electrical Engineers was held at the Edison Auditorium, New York city, Friday, October 26, with President Samuel Sheldon in the chair.

Secretary Pope announced that at a meeting of the board of directors held Friday afternoon, forty-one associates had been elected and the following associates had been transferred to the grade of member: Armin Henry Pikler, Ampere, N. J.; Otto Martin Rau, Milwaukee, Wis.; Warren Ray Thompson, Manchester, England; Arthur Bowers Stitzer, Philadelphia, Pa.; Arthur Thomas Cooper, Bombay, India; Thomas Hesketh, Folkstone, England; Allen Harwood Babcock, Oakland, Cal.; Herbert C. Work, Schenectady, N. Y.; Harry Guthrie Spain, British Guiana, South America; Theodore Hanamann Schoepf, London, England; Sebastian Ziana De Ferranti, London, England; John Francis Cleverton Snell, Sunderland, England; Alois John Joseph Pfeiffer, Calcutta, India; Harry Lepper Kirker, Pittsburg, Pa.; Robert Hammond, London, England; Arthur William Beresford, Milwaukee, Wis.

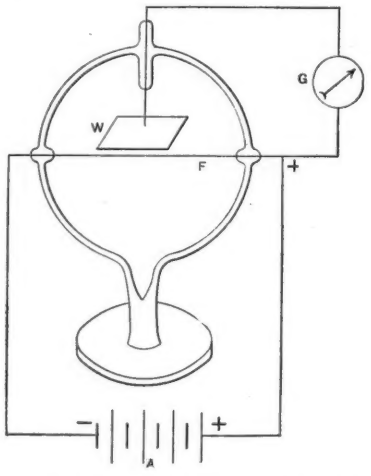


FIG. 1.—APPARATUS FOR STUDYING EFFECT OF HERTZIAN OSCILLATIONS UPON IONIZED GASES.

The secretary also reported that at the meeting of the board of directors the representatives of the Institute on the joint building committee of the Engineering Building reported that they had promises that the building would be practically ready for occupancy on December 1, and it would be in use by December 15, to be occupied by the officers and staff of the three societies. However, no meetings will be held there, and no opening of an official character, until April next, as it is the intention to make the opening rather an important event in the engineering history of the country.

The paper for the evening, entitled "The Audion; a New Receiver for Wireless Telegraphy," was read by Dr. Lee De Forest.

While making experiments in wireless telegraphy at night, during 1900, it was found that the Welsbach mantle was sensitive to the sound of the induction coil spark. This led to a search for a similar effect due to Hertzian waves and it was found that they would cause a variation in the current passing through a luminous flame, which could be detected by means of a telephone receiver. This effect was studied carefully. The best results are given by a Bunsen flame rendered luminous by potassium or sodium vapor. The sensitiveness of the detector, which has been called the "audion," is of the same order as that of the electrolytic detector. The same effect may be observed in the electric arc. The action is undoubtedly connected with the ionization of the gases and inasmuch as the gases ionize more readily at lower heats and are in their most mobile, delicate, and sensitive conditions in vacuum, it seemed certain, after experiments with the flame, that the attenuated and ionized gases around an incandescent filament would undergo very considerable changes when subjected to Hertzian oscillations. Fig. 1 shows an arrangement of apparatus for studying the effect. If the battery A brings the platinum wire F to incandescence and a leakage current will be set up between the wire F and the plate W, which may be detected by the galvanometer. The current passes mainly to that portion of the filament near its negative terminal. The current increases rapidly with the heating current through the filament, which increases the velocity of the negative ions, as does also an applied electromotive force between plate and filament.

In the form of "audion" illustrated in Fig. 2 two platinum wings are placed parallel to the plane of the bowed filament and about two millimetres on either side of it. These wings are soon coated with an iridescent deposit from the metal filament, especially at the portions opposite to the negative half of the filament. They become quite hot at this short distance, but not sufficiently hot to take part in the ionization of the gas.

When connected in the oscillation circuit as shown, properly attuned to the receiving electromagnetic impulse from the antenna, the "audion," under proper adjustment of heating current and battery B potential, is extremely sensitive, giving response in the receiving telephone several times as loud as any other form of wireless receiver when subjected to the same impulses. It is, however, less sensitive to atmospheric or static disturbances, which are strongly damped or a-periodic. Its operation seems to be dependent upon the sum total of the energy received from the complete wave-train rather than upon the maximum first impulse of the train. In other words, while instantaneous as far as our senses or instruments can perceive, its action is sufficiently sluggish to be determined by the additive effect of the entire received electroradiant energy through a short time-interval.

The "audion," to a greater extent than any other responder, is self-tuned. By regulating the heating current, the potential between wing and filament, or the distance between these, the "audion" can be made to a great extent selective *per se* to certain received impulses. And the determining factor here is not merely the frequency of the electrical oscillation; the spark frequency, or factors determining the total amount of energy received during a very brief unit of time, determine to an extent the amount of its response. Thus with twelve volts across it, it may give a loud response to a transmitter A; and with ten volts bring in another transmitter B to the almost complete exclusion of A, although A and B are of equal power and of approximately the same wave-length, but differing considerably in spark frequency. Similar discrimination can be produced by adjustments of the heat of the filament, which also governs the amount of flux through the gas.

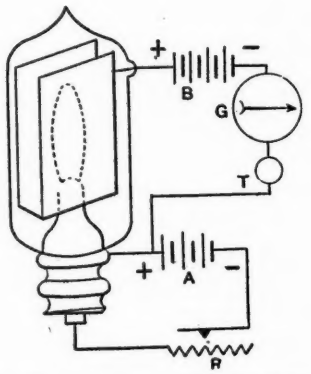


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF "AUDION."

It is not necessary to connect the anode to a terminal of the oscillating circuit. One terminal may be attached to a metal sheath or ring surrounding the glass vessel, thus forming a condenser with the filament or the conducting gas within the

tube. In this condenser arrangement the sound heard in the telephone changes its quality to an extraordinary degree, being of a dull muffled nature rather than sharp and staccato. Signals of this quality are sometimes much more readily distinguished from the static disturbances which so frequently render wireless signals difficult to read. The operator has thus a ready means of changing the quality of the received signals to suit the conditions. This latter type of "audion" is the one found most serviceable in practice.

The "audion" may even be placed in the space between two plates of an air condenser in the oscillating circuit. A flat-walled type of tube is preferred for this arrangement. Again the electrical oscillation may be led through a coil of wire wound round the outside of the tube, and not through the "audion" at all, or through a flat coil brought up close to the tube, with its axis perpendicular to the filament. In this arrangement it is chiefly the electromagnetic component of the passing oscillation which affects the motion of the ions within the vessel. The ions are readily influenced by a magnetic field.

Dr. De Forest has arrived as yet at no completely satisfactory theory as to the

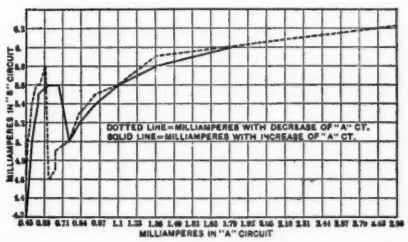

DOTTED LINE=MILLIAMPERES WITH DECREASE OF "A" CT.
SOLID LINE=MILLIAMPERES WITH INCREASE OF "A" CT.
MILLIAMPERES IN "B" CIRCUIT
MILLIAMPERES IN "A" CIRCUIT

FIG. 3.—DIAGRAM SHOWING THE BEHAVIOR OF THE TWO-ELECTRODE "AUDION."

exact means by which the high-frequency oscillations affect so markedly the behavior of an ionized gas. Fleming points out that when the cold plate of the Elster-Geitel tube is connected to the positive end of the filament, and the two put in a high-frequency oscillation circuit, only the positive half of the oscillation can pass from the plate to the filament across the gas. He uses this principle to rectify the Hertzian oscillations, and applies the unidirectional currents of the oscillations themselves to operate a sensitive galvanometer, or direct-current instrument, for quantitative measurements over very short distances. When an independent external source of electromotive force is applied, in the manner described, the action becomes quite different. It then operates as a relay to the Hertzian energy instead of merely rectifying this energy so that it can be used directly to give the sense signal.

The "audion" therefore is tremendously more sensitive and available in practical wireless. A sensitive direct-current instrument in the B circuit shows a steady deflection varying not a whit, by increase or decrease, during the reception of strong wireless signals. An electrolytic receiver or "polariphone" under similar conditions would cause a great deviation in the deflection of a milliammeter, although the signals in the telephone with the electrolytic are not so loud as with the "audion."

When the anode consists of two parallel plates instead of a cylinder there will be a maximum of positive electric density along their vertical edges. The more intense parts of the electric field will involve the larger number of ions, and on the anode these will generally be located at the vertical edges of the parallel plates, provided these are not too far from the filament.

With this type of anode a peculiar and sudden inflection point in the current-flux diagram, as the heating current is gradually increased or decreased, is noticed. The flux goes on increasing, then suddenly drops back to a lesser value; at the same time a click is heard in the telephone in the B circuit. Then as the heating current is still further increased the B flux is again increased. These same cusp points in the curve are obtained if the A circuit be kept constant and the B voltage be increased instead.

Similarly a click is heard when the flux current is being reduced from a higher value, only the location of the cusp on the curve of decreasing current is not coincident with but lags behind that observed when B is being increased. This second cusp point shows a sudden increase in the flux current, when the critical point is reached, to a value previously passed through. The sharpness of these cusp points can be smoothed out or quite obliterated by putting impedance in the B circuit in series with the telephone.

The diagram (Fig. 3) shows the relative magnitude of these sudden alterations in the flux current obtained with a certain sample "audion," and Fig. 4 the decided hysteresis effect, showing how the actual B current lags behind the increasing or decreasing electric field which produces it.

These hysteresis curves are always obtained even though the anode is in the form of a cylinder or flattened cylinder without the vertical edges; but the reactive cusp points in the curves are never obtained save with the plane anodes.

In framing any theory of the action of electric oscillations in the "audion" a variety of complex, contradictory phenomena is met with, exceedingly puzzling to explain. An example is the fact that a continuous-current instrument in either the A or the B circuit shows absolutely no change of deflection, either of increase or decrease, when B is large and the "audion" in its most sensitive condition. If only the positive halves of the oscillations pass from anode to filament these should increase the reading of a milliammeter in the B circuit during the passage of a long series of wave-trains of sufficient intensity. Or else the negative halves of these oscillations might be expected to diminish to a greater degree the positive charge on the anode, and result

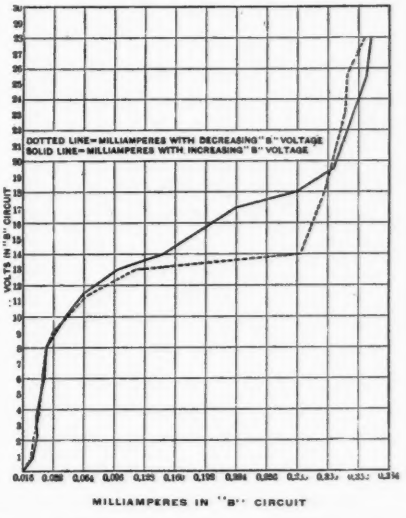

DOTTED LINE=MILLIAMPERES WITH DECREASING "B" VOLTAGE
SOLID LINE=MILLIAMPERES WITH INCREASING "B" VOLTAGE
VOLTS IN "B" CIRCUIT
MILLIAMPERES IN "B" CIRCUIT

FIG. 4.—DIAGRAM SHOWING THE HYSTERESIS OR CURRENT LAG IN THE "AUDION."

in a diminution of the B circuit. Or if both of these acted equally and oppositely no signal would be obtained at all, for the telephone diaphragm is utterly incapable of following such rapid increase and decrease in the B current, even if its impedance would allow these pulsations to pass through the circuit. Neither would the ear detect such vibrations.

If on the other hand the integrated effect of a complete Hertzian wave-train were either to increase or decrease the B flux, a long succession of such effects, all of which must be of the same sign, ought to cause a change in the needle's deflection, as when a long Morse dash is sent out from the transmitting station. We have no reason to suppose that one wave-train, the result of one spark, would produce a momentary decrease in the B flux, indicated by a click in the telephone,

and that the next succeeding wave-train from the next spark would cause an opposite increase in the B flux, and another similar click in the telephone. Such action would of course explain why a loud sound in the telephone might not be accompanied by any change in the sluggish ammeter reading, similar to the case of the magnetic detector.

The following explanation of the phenomena which seems to account for many of the peculiarities of this paradox has been suggested. It should be remembered that if the negative half of the electric oscillation can not pass through the gas from cold anode to the filament, the "audion" electrodes during that half-period will act merely as the two armatures of a condenser. Even when close together, their mutual capacity, when the gas is cold, is exceedingly small, and only a very small positive charge can be held bound on the filament; or if there are sufficient free positive ions in the hot gap the complimentary positive charge will be held just on the outside of the "variation layer" at the anode.

The falls of potential across the variation layers at anode and cathode are proportional to the squares of the velocities of the positive and negative ions; and the ionic velocities are proportional to the electric forces acting upon them. Supposing then that during the positive half of the electric oscillations the velocity of the positive ions is increased at the anode layer, and during the other half period the velocity of the negative ions is increased, due to the changes in the electric force acting upon them. Then, regardless of the sign of the change of the velocities, the potential drop across the variation layers (which varies with the square of these changes) will be increased during the entire passage of the oscillation train.

The layer will act during this interval like a condenser, the potential drop across which is momentarily increased, which momentary increase will disappear with the passage of the wave-train. It will be as if the plates of a charged air condenser were suddenly further separated and then brought suddenly back to their normal positions; or as if the specific inductive capacity of the dielectric were decreased and then increased. This operation being repeated for every spark at the transmitter, a listener in the telephone in the B circuit will hear a sound whose pitch is exactly that of the spark, while a milliammeter in that circuit will show no variation in its deflection.

As the fall of potential across the variation layers is proportional to the square of the current passing, and to that of the impelling electric force it is readily understood how, by regulating the heating current and the B voltage, an optimum value of the electrode drop may be obtained for which the effect from any given received impulses will be a maximum. Also how by varying the distance between the electrodes the sensitiveness of response may be regulated.

Thomson shows that at low gas pressures and high ionic velocities the ions, when placed in a strong magnetic field, will travel along the lines of strong magnetic force; but when the product of velocity and field is small the ion moves parallel to the electric force. In the "audion," if the lines of a strong magnetic field pass through the gas parallel to the plane of the anodes, a marked reduction in the flux is obtained, sometimes amounting to twenty per cent. When the magnetic lines pass perpendicular to the plane of the wings the negative ions which are traveling in the direction of the magnetic force, from filament to wing, will be accelerated, but those originally traveling out from the filament in the opposite direction will be bent around or deflected from their direct paths; so the resultant will be a decrease of the total current flux. When the field is intense, a marked frying or hissing sound in the telephone is heard, especially with the two-wing anode, and when the magnetic force is parallel to their plane and thus affecting mostly the ions which are streaming towards their vertical edges.

A very convenient form of "audion" for investigating the relations which the distance, area, etc., of the electrodes bear to its response is had by using a pool of mercury for the anode. This is conveniently held in one or more pockets blown in the walls of the glass vessel, and the filament so placed as to pass closer to some than to others.

A large number of experiments have been carried out with a view to reducing the filament heat necessary to give the enclosed type of the "audion" the extreme sensitiveness which now characterizes it. This is now attained at normal brilliancy of the filament, or a little below; never at excessive heats. Thus the life of an "audion" should be that of an incandescent lamp of the same class of filament and voltage.

Filaments have been coated with alkali metals or salts, or vapors of these introduced into the tubes. Experiments along these lines and with various dissociable gases are being pushed with gratifying promise of our soon being able to achieve the present marked sensitiveness even at red heats; or of still further multiplying the sensitiveness.

Radioactive compounds, applied for example between juxtaposed metal disks and heated, give little encouragement. At the low voltages used no increase of conductivity by their means has been observed. Spontaneous ionization; that is, the ionization independent of the electric field as for example that produced by the X-rays, does not increase the current flux. Only the ions produced by the electric field itself close to the cathode, and by the heat of the cathode, is effective.

It is required that the "audion" be made with scrupulous care; a trace of impurity in the gas may produce surprisingly large effects in the potential drop across the variation layers. The presence of a mere trace of moisture may cause great difference in the behavior of a tube.

Dr. M. I. Pupin, in opening the discussion, said the number of detectors of wireless waves seems to be increasing indefinitely. He objected to the plan of inventing a new name for each device and criticized the term "audion" as philologically incorrect. It is a Latin word with a Greek ending. Acouion might have been better, but more difficult to pronounce. Although the device forms a new wave detector, the physics of the thing is old. Hittorf, over fifty years ago, discovered that in a vacuum tube very high electric tensions would produce no perceptible discharge, but that the heating of the cathode facilitated the passage of electricity to such an extent that a small electromotive force, a few volts, would produce perceptible current. Dr. De Forest devotes some attention in the first part of his paper to a detector of the new type in which the gases are at ordinary pressures, but abandons this form because it is variable, and turns to the vacuum tube, as the same phenomenon should exist there and one would expect a very much greater steadiness and reliability, which is one of the highest desiderata in any technical work, particularly in wireless telegraph.

A complete physical explanation of the phenomena is difficult. The current through the gas is steady as far as a milliammeter can tell. It is not steady as far as the telephone can tell. Therefore it can not be that the waves are rectified. The only other thing we can guess, as possibly happening, is that the oscillation passes through the whole circuit, but on account of some effect upon the gaseous part of the circuit, the resistance, or the

diminution or increase of some of the other reactions, the original current is strengthened very much at certain intervals during one-half of the waves, and weakened during the other half, or strengthened on each side of the wave. That, as Dr. De Forest points out, is also impossible to believe, because the oscillations being so rapid, could not very well pass through the winding of the telephone in the first place, and in the second place could not be expected to produce a very large magnetic effect upon the diaphragm. Dr. Pupin cautioned against placing too much reliance upon the telephone. He has used it for years for detecting faint sounds, faint differences of potential, and faint currents, and found it one of the most tricky instruments one can use.

Percy H. Thomas said apparently the new device is another illustration of the new theory in electrical science—an apparatus depending on corpuscles or ions. As Dr. Pupin has said, the way to make use of corpuscles, if you want to use them, is to get them into a vacuum where you can control them. But these corpuscles or electrons do not exist in a free state ordinarily, any more than sodium or chlorine, or other materials do. If you want to use them you must produce them, and there are many ways of producing them. In the "audion" we have such a means. In the first place we have a vacuum, which allows a more or less free movement, and we have a means of controlling and directing the ions, that is the additional battery electromotive force. And then we have, further, the waves which come in on the transmission circuit, which, in some way or other, which is not understood, so affect the action of the corpuscles as to make a sound in the telephone.

Sewall Cabot asked whether the statement that the device is self-tuning referred to the ability to alter the electrostatic capacity of the "audion," which would itself be in a tuning circuit, and thereby altering the tuning of the circuit, or does it simply refer to the tuning of the spark frequency, that is, by changing the battery potential, having the "audion" more or less responsive to relatively slow frequencies.

Dr. De Forest replied that both effects are present, but as the capacity is small, it has less effect.

E. P. Thompson thought the action of the "audion" might be due to electrostatic effects and described an electrostatic telephone receiver. Or the device may be nothing more than the old Hertzian receiver, consisting of two terminals forming a spark gap.

Frank J. Vreeland pointed out the similarity of action in the electrolytic detector, the "audion" and Fleming's vacuum valve, and said that as a telephone is certainly sensitive to a current of a millionth of an ampere, might it not be possible that there was a unidirectional polarized current sufficient to affect the telephone and not sufficient to affect the instrument used.

Dr. De Forest said it might have had that effect, but at the same time signals were obtained which could be described as tremendously loud in the telephone, but caused no change of deflection of the ammeter, and there was no reason to suppose that as these signals got weaker in the telephone they would become unidirectional, or if so there was no reason to suppose they should when they are weak give an effect entirely lacking when they are strong. He was inclined to believe the effect was due to alternating currents. As to the name "audion," when one uses a term 100 times a day, it is necessary to have something brief. Replying to a question asked by J. B. Taylor, the sound heard in the telephone represents the spark frequency. The currents causing the sound are undoubtedly alternating, rather than polarized. The intensity of the signals is at times so great that there is no doubt of their being caused by an electromagnetic current flowing through the telephone, and not electrostatic effects, although the latter undoubtedly exist, and under certain conditions may predominate.

The meeting was then adjourned.

The Irish International Exhibition.

The Irish International Exhibition will be held at Dublin, Ireland, from May to October, 1907. This will be the biggest undertaking of its kind ever organized by Irishmen, and it is expected that it will completely dwarf any of the exhibitions previously held. Subscriptions to the guarantee fund new exceed $900,000. Work on the exhibit buildings is going forward rapidly, and it is announced that they will be finished some months before the date set for opening, May 1, 1907.

The exhibits will be classified in nineteen sections, and in the transportation and machinery section a number of prominent companies will be represented. Among these are the Great Southwestern Railway Company, the Dublin, Wicklow & Wexford Railway Company, the Great Western Railway Company, Messrs. Harland & Wolff, the White Star Line, Royal Pacific Steam Packet Company, the Cunard Steamship Company, Babcock & Wilcox Company, Combe & Barbour, and the British Westinghouse Company.

The secretary of the exhibition is James Shanks, Ballsbridge, Dublin, Ireland.

An Important Movement for the Introduction of New Electric Lighting and Transit Systems in New York City.

Considerable interest has been aroused by the reorganization of the Long Acre Electric Light and Power Company, which recently obtained from Justice Dowling, of the Supreme Court, a peremptory mandamus directed to the Electrical Subway Company compelling the admission of its electric light wires to the conduits owned by the subway company. The Long Acre Electric Light and Power Company, it is understood, is preparing to begin work under its franchise to furnish electric light to the full extent of its capacity. The entire holdings of this company were recently purchased by John C. Sheehan and associates, and they also purchased from Joseph H. Hoadley the rights and equipment of the Manhattan Transit Company. In addition to the development of power-houses for the lighting system of the city it is the intention of the company to institute a line of auto buses, which, it is expected, will go a long way toward solving the problem of city traffic.

The power-stations of the Long Acre Electric Light and Power Company will very likely be equipped with oil-engine-driven units. This will afford an exceptional opportunity for the utilization of the American Diesel oil engines, the builders of these machines being closely connected with the interests controlling the Long Acre Electric Light and Power Company. It is understood that the new company is planning to sell current for light and power at rates considerably lower than those now charged in the city, and with the use of the internal-combustion motor as a prime mover it is expected that an almost ideal power-station system can be secured.

At a meeting of the directors of the Long Acre Electric Light and Power Company on Monday, October 22, Edgar Van Etten, William J. Clark and William H. Lamprecht were elected members of the board. Mr. Clark is general manager of the Foreign Department of the General Electric Company, Mr. Van Etten is second vice-president of the New York Central & Hudson River Railroad, in charge of the Boston & Albany division, and Mr. Lamprecht is a member of the banking house of Lamprecht Brothers, Cleveland, Ohio.

ELECTRIC RAILWAYS IN SPARSELY SETTLED COMMUNITIES—I.[1]

BY E. P. ROBERTS.

The special report of the United States Census Office relative to Street and Electric Railways, 1902, undoubtedly contains much information of value, but the data therein presented has frequently been misused. Average results for the United States or for individual states have been considered as applicable to a proposed road; whereas, in the writer's opinion, each proposition must be considered by itself, and only such statistics applied as are obtained from roads which are properly comparative, and as no two roads are identical, allowance must be made for the difference between the proposed road and such road or roads as are compared therewith. Even the fact that the proposed road has the same terminal city as the roads with which it is to be compared, and has the same population per mile of road, does not make the two propositions strictly comparative.

The writer has always felt very strongly that each case must be considered by itself, but in view of several inquiries recently received, asking how we figure probable earnings of interurban railways, and whether it is not possible to obtain an empirical formula which would have some value, we prepared several tables and attempted to obtain a curve which might have some value. Curiously enough, the first eight or ten roads tabulated gave such results as checked, with not an excessive variation, with the empirical formula suggested by one of our engineers; but even then there was such variation as would be sufficient to make the difference between profit and loss. This formula is based on allowing a certain annual income per capita from the population in the principal city, a greater amount in the towns, and a still greater amount in the country; but applying some additional data, we found that for many roads the suggested formula had no value at all. The population taken as being along the route is not based on that within a certain distance of the road, but is based on local conditions. To ascertain same necessitates more time and skill than when the latter method is followed, but it is the one which I consider proper.

We always consider the entire population directly on the route, and when one city greatly preponderates exclusive of such principal city, but noting the population of such city, and when there is no such greatly preponderating city we consider all the population. For sections a greater or less distance from the route we use a percentage based on local conditions, and take into account the character of the population, the reasons for travel, the comparative facilities, including accessibility, etc. For example: Near the principal city a person residing three miles or less from the corporation limits of the city, and three miles from the proposed road, would seldom if ever use same, whereas, if he were a considerable greater distance from the city, and three miles from the road, he would use it almost as much as if he lived directly on the route, provided that there was not another electric or a steam road nearer to him. If such road were a steam road consideration would be given to the service provided by it.

It is also evident that if the location of the proposed road is along a river, especially of considerable width, and having a few bridges, the population on the other side of the river from the road has lessened in value; it might not, geographically speaking, be a quarter of a mile distant, but from the standpoint of accessibility may actually be several miles away. In some cases, and because of connection with steam or electric railways, or river transportation, or existing stage routes, considerable value should be given to a population at a considerable distance from the route, whereas in other cases, and as above indicated, the population quite near the route may have little value.

The population so obtained is what we term the "equivalent" population, by which is meant the population which, if all of it were directly on the route, would equal in amount of travel the actual population as it is actually located. For example: a population of 1,000 may be considered as equal to 100 or 200 or more directly on the route.

Relative to the population, our custom is to take the 1890 and 1900 census and note the rate of growth, and also to give due consideration to the school and voting population, etc., and checking any statements as to unusual growth, or growth at a more rapid rate than between 1890 and 1900.

Relative to the population which should be considered, we give separate value to the principal terminal city when it is much larger than any other city along the route. The writer's present opinion is that usually it makes little difference to the interurban road whether the principal city has 100,000 or 500,000 population, provided that it is the principal city in that general section of the country, and therefore the one to which all business tends.

The receipts per capita depend upon the reasons for travel, comparative facilities, habits of the people, character of population, comparative costs of travel, etc., and to apply any statistics requires not only a careful study of the conditions relative to the proposed road, but also a full knowledge of the conditions relative to the roads from which the statistics are taken and a careful differentiation and application of such statistics.

An examination relative to an operating or proposed electric railroad necessitates the application of personal judgment and, to a greater or less degree, the application of statistics—and, before giving detailed consideration to such examination, it may be well to state the object of such examinations.

The examination of an operating plant is generally in order to ascertain its existing income, gross and net, the past rate of increase of same, and the probability as to the future, its physical value and whether it is economically advisable to make additions and improvements. An examination is also made of the franchises and of other matters outside of the construction and operating features.

The examination of the income and expenses is, as nearly as possible, in accordance with the standard classification of accounts prepared by the American Street and Interurban Railway Accountants' Association, and statistics obtained from other roads are compared therewith in order to note any considerable variations from what may be considered as normal, and the reasons for any such variation are investigated. Sometimes actual statistics obtained from other roads are not referred to, because the investigator has such knowledge as enables him to apply results he has elsewhere obtained to the case under consideration, and he may do so unconsciously. But whether consciously or unconsciously he uses statistics is immaterial, the principal point being that he does use and compares them with local conditions and applies personal judgment.

If the examination is relative to a proposed road it must include a predetermination of all the factors entering into total cost, both first cost and operating, also income, both gross and net, and evidently requires not only a wide experience, but also excellent judgment in the application of statistics.

The object of an investigation as to the

[1] Abstracted from a paper read at the convention of the American Street and Interurban Railway Association, Columbus, October 18

advisability of constructing a proposed interurban electric road is evidently to ascertain the probable resulting net earnings per dollar invested. In order to arrive at such conclusion it is necessary to ascertain the probable gross income, the total first cost and the consequent resulting financial charge and the operating expense. Logically, these matters should be taken up in the order above stated, but in many respects they are inter-dependent, and are considered simultaneously.

The probable income. This may be from several sources—passenger, express, carload freight, mail, advertising and, in some cases, the sale of electric energy for light and power. The last three sources will be disregarded and consideration merely given to the income from passengers, express and freight.

Having obtained the equivalent population in the manner previously described, the next and most important step is to determine the probable income per capita. Consideration must be given to the reasons for travel, comparative existing facilities, including railway time-tables and rates, and possibilities or probabilities of existing, or of other proposed, roads furnishing increased facilities. The habits of the people must be studied, the existing trend of traffic and every factor which may influence the situation. Some of these factors can be given an approximately definite value, and others are largely a matter of experience. To each must be applied personal judgment and the actual or unconscious application of statistics obtained from other roads having conditions more or less analogous to those of the projected road, and upon the ability to ascertain the conditions and properly apply the results elsewhere obtained depends the accuracy of the predetermination.

The above refers more especially to passenger travel, but practically the same method is followed in connection with freight, both package and box freight, including milk, garden truck, etc., also mail, although the latter is not generally of great financial value, but policy may make it desirable.

Express matter and so-called package freight can usually be carried either in a special compartment of a regular car or in a special express car similar in general makeup to the passenger car used on the road, and, in either case, can be handled without interfering with the regular schedule and without any extraordinary demands for power. Bulk freight, on the other hand, to be profitable must be handled in fairly large quantities, and this requires the operation of train units of several cars. If such trains are run in the daytime when the regular passenger traffic is on the road, it necessarily interferes more or less with the regularity of the passenger schedule, as such trains move at slower speeds than the passenger trains.

Having predeterminated the obtainable traffic, the next step is to decide as to the traffic facilities which must be furnished for the anticipated business. Undoubtedly, a map has been available from the start, and the general location of the proposed road has been marked thereon, from which distances between the principal points have been ascertained. The specialist also has gone over the route and is fairly well informed as to the physical conditions, and, in a general way, the most desirable locations, both in the country and in the cities and towns, also the practicability of obtaining such locations. In fact, he is quite well informed, not only as to the general situation, but also as to the business situation, probable character of franchises obtainable, legal conditions, etc. If the country is reasonably level, he is able to approximate the cost of the grade, has ascertained the probable length of bridges required, and, from the maps obtained distances with sufficient accuracy for a preliminary study. If the country is rather rough, a topographical survey is exceedingly helpful, and quite frequently can be obtained from the United States Geological Survey. In some cases it is desirable to make at least a preliminary survey before the proposition has proceeded very far, but in many cases this is not only unnecessary but actually inadvisable, as it necessarily indicates the most probable route and frequently increases the cost of right of way. A time must arrive when the location becomes evident, but there are methods of procedure which minimize the tendency to increase the cost of the right of way which practically always follows such publicity.

Having a preliminary map and possibly a profile of the route, train schedules and train sheets are prepared in order to ascertain the approximate time of the runs of the various classes of trains (each of which may consist of one or more cars), and which are of importance in determining the number of cars required, the motor equipment for each car, the amount of power required, the location of substations and other matters. Of course, at this time such schedules and train sheets are of a preliminary character, and are liable to modification after a final map and profile have been obtained, and also numerous other matters have been definitely decided, but a competent man will prepare the preliminary schedule with a very close approximation to the final ones.

Some of the questions which will arise at this point are as follows:

With a preliminary map which shows the length of the road, and the length of the run in cities, towns and country, including the length in the principal terminal cities, and knowing that it is desirable that passenger cars should be operated at regular intervals, starting from terminal points, preferably on the hour, half hour or quarter hours; also knowing that the cost of train crews is one of the principal expenses, and consequently that the layovers at the ends of the route should not be greater than necessary for unloading and loading the cars, with sufficient allowance for delays in reaching such terminal points, and not forgetting that increased speed necessitates, for any given size and weight of car, greater capacity of motors, and also increased cost of the power equipment, including motors, substation and power-house machinery; also knowing that the runs in the cities and towns are under city regulation as to speed and, therefore, can not be increased by higher-speed motors; also realizing that increased stops in the country materially decrease schedule speed, the proposition is to so combine all these factors as to obtain the best *net* result.

In such study, consideration must also be given to grades, grade crossings with other railways, and, to some extent, of highways; also, in some cases, the service given by competing roads, either steam or electric. It is a fact that the income per capita in the country will generally be greater than from that in towns, but an effort to obtain every dollar possible from the country may be exceedingly poor economy. It might be considered that this is a matter of policy to be determined by the management, but it is of vital importance in connection with the design, if the design is to be such as will give the best returns per dollar invested.

The consideration of the route may start with the principal terminal city, and it is of great importance to have the terminal station in such city well located relative to the retail district, which is generally also the amusement centre.

(To be concluded.)

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Railway Coach Electrification.

The adoption of electric traction on the Metropolitan Railway, London, left the company with nine trains, each consisting of seven cars, which had formerly been hauled by steam locomotives. These cars were built in 1900, and it was decided to fit them up for electric traction rather than discard them. The work was undertaken by the British Thomson-Houston Company, and two trains fitted up, which have been in operation for some time satisfactorily. Each train consists of seven cars, and is made up of two motor cars and five trailers, although it is planned to add an extra trailer after the station platforms have been lengthened. Each motor car is equipped with four 200-horse-power motors, thus giving a total of 1,600 horse-power per train. It is capable of driving it at a maximum schedule speed of forty-five miles an hour on the level, when making a schedule speed of sixteen miles per hour. The trains are controlled by the Sprague-Thomson-Houston multiple unit control system. The motor cars weigh, complete, about thirty-eight tons, and the trail cars nineteen tons. A complete train weighs about 172 tons. In converting these cars the trail cars were not altered in any way except by the addition of the necessary wiring for lighting, heating and motor control. In the motor cars longitudinal channels have been substituted for the diagonals in the under frames over the centre of the trucks, in order to facilitate inspection of the motors, and to allow of better arrangement of the wiring. All wires and cables are enclosed in cold-drawn solid steel tubing with standard thread and fittings. The entire under sides of the floors of the motor cars are sheeted over with one-half-inch Uralite, while the upper surface is provided with a three-quarter-inch layer of Paris cement. The surfaces of the floors of the trailers are similarly treated, and that portion of the under side directly above the wiring is also protected by Uralite.—*Abstracted from the Tramway and Railway World (London), October* 4.

Radium and Geology.

Recent papers dealing with the idea that the earth's internal heat is due to the content of radium within its crust have led O. Fisher to examine the matter from the geological standpoint. Strutt has shown that if the temperature of the gradient expresses the outflow of heat due to radium in the earth, the radium must be confined to a comparatively thin crust, because his laboratory experiments proved that the smallest radium content existing in the rocks examined would give a much higher gradient than the one observed if the radium were distributed throughout the entire earth. The author examined this suggestion more closely. Defining first the earth's crust by the depth beyond which no heat is caused by radium, and by adopting a certain temperature gradient at the surface, there is left only one value of the radium content which will correspond to any assumed thickness of the crust, and there will also be one corresponding temperature at the bottom of the crust and throughout the interior. The author has calculated these at intervals of five miles for Prestwich's estimate of the gradient, which is one degree Fahrenheit for each 42.2 feet descent; and also for the more commonly accepted one of one degree Fahrenheit for sixty feet. The results are given in tabular form. With the first gradient he finds that with a thickness of fifteen miles the radium content is 15.39×10^{-12} grammes per cubic centimetre and the temperature at the bottom of the crust is 966 degrees Fahrenheit. At a depth of thirty miles the figures are 7.7×10^{-12} and 1,900 degrees, and at forty-five miles they are 5.13×10^{-12} and 2,834 degrees respectively. Assuming the lower gradient, the temperature at a depth of fifteen miles is 676 degrees Fahrenheit, and the radium content 10.27×10^{-12} grammes per cubic centimetre. At thirty miles the figures are 1,330 and 5.09×10^{-12}, and at forty-five miles, 1,984 degrees and 3.59×10^{-12} grammes respectively. From these figures it appears that the radium contents corresponding to such values as are usually assigned to the thickness of the earth's crust by geologists and seismologists are well within the amounts contained in the rocks examined by Strutt, and that consequently the surface gradient can be fairly accounted for by the theory. But there are also indications of internal temperature from volcanic products, as Bartoli found the temperature of lava issuing from Ætna to be 1,060 degrees centigrade. If this came up from beneath the crust it would correspond to a thickness of thirty to forty miles, according to the rate of increase which is attributed to the gradient. Since any reasonable assumption for the mean radium content of the crust would supply sufficient heat to maintain the observed gradient, it follows that no heat can pass up from the interior. The conclusion would be that the earth is not a cooling body, but is in a state of thermal stability; and a fundamental belief of geologists is thus shattered at a blow.—*Abstracted from Nature (London), October* 11.

Electricity in Steel Works.

The severe conditions to be met by the motive power employed in steel works make it necessary, when electric motors are employed, to use special designs or to adopt some load-balancing scheme. A recent installation of this kind has been made for the McKenna Process Company, of Birkenhead, England. The plant consists of three turbine-driven, three-phase, twenty-five-cycle generators, each rated at 750 kilowatts. These supply current at 450 volts to 500-horse-power motors for driving a series of rolling mills, and to other motor-driven apparatus. For driving the live rolls special Siemens motors have been installed. They are three-phase motors designed with special end plates so as to give rigid support to the bearing. The electrical characteristics of these motors are specially designed to enable them to withstand heavy rushes of current which occur at starting and reversing. The motors are controlled by resistance introduced into the secondary. The controllers are fitted with contact fingers having massive carbon tips and magnetic blowouts, mechanical resistances being employed. Another type of controller which is used for these motors is of the liquid type. The electrodes are fixed and the resistance is varied by changing the height of the electrolyte. A serious question in steel plants is the large variation in load due to the rolls. To neutralize these peaks the most frequent plan is to

place a flywheel on the motor, care being taken to design the characteristics of the motor so as to permit a considerable drop in speed, in order to get the benefit of the flywheel. There are cases, however, in which the peak loads are either so high or of so large duration that, in order to neutralize them completely, the weight of the flywheel would be prohibitive. In such cases the demand on the generating station may be supplied by a storage battery or by a plan which is a modification of the Ilgner system of mine hoisting. A motor-generator set is installed, consisting of a three-phase induction motor of suitable characteristics, and a direct-current generator. The latter is connected directly to a motor coupled to the rolls. An exciter is coupled to the generator shaft as is also a heavy flywheel suitably mounted. During the periods of light load the motor-generator speeds up, storing up energy in the flywheel, which later is used in starting the rolls or in overcoming resistance. To reverse the machine the generator field is reversed and the motor, acting as a generator, is brought to rest, storing up its kinetic energy in the flywheel, which is then used to bring it up to speed in the opposite direction. This system is being used with excellent results, load diagrams showing how the sudden and intermittent loads on the motor are converted into a very smooth load on the generating plant.—*Abstracted from the Electrical Review (London), October* 12.

The Duration of the After-Glow Produced by the Electrodeless Ring Discharge.

An investigation of the duration of the after-glow produced by the electrodeless ring discharge—that is to say, by an induced current set up within an exhausted tube by a coil placed outside of it—has been made by C. C. Trowbridge. A brief resumé is given of previous investigations of this phenomenon, none of which, however, has dealt with the duration of the glow. The first attempt to study it was made by setting up an electrical oscillation in a coil surrounding a tube which could be exhausted to any desired degree. But the discharge caused phosphorescence of the glass, which masked the phosphorescence of the gas. To get around this difficulty a second tube was attached to the one in which the discharge was caused to take place. After the discharge had taken place the phosphorescent gas was allowed to diffuse into the second tube, and its behavior watched. The duration of the after-glow is taken as the time between the instant of the secession of the electrodeless discharge and that when the after-glow becomes invisible, the time being registered by a stop-watch, which gave concordant results provided that any one series of experiments was carried out continuously, for it was found that if the gas were allowed to stand in the tube for some days the results did not agree. The author concludes that the visible duration of the after-glow can be measured with considerable precision if the eyes of the observer are protected from strong light, so as to secure constant sensitiveness of the retina. With an electrical system remaining the same, similar duration curves showing the change of duration and change of pressure can be formed, giving the same characteristic points of inflection, maxima and minima. But variation in duration in some curves may occur, owing to changes which take place in the gas. The after-glows thus far observed appear over a range from 2.4 to 0.002 millimetres pressure. The maximum of intensity of the after-glow and the maximum of duration are nearly coincident only at low electrical intensities. There is a critical point on the duration curve where the after-glow is only occasionally formed, and, when obtained, varies greatly in duration and intensity. This point corresponds closely to the pressure at which the white discharge begins. The position of the maximum of the curve, giving a change of duration with change of pressure, varies with the frequency of oscillation of the discharge, a greater frequency moving the maximum of duration toward higher pressure. When the discharge is caused to take place in gas at the temperature of liquid air, the intensity and duration of the after-glow are both greatly diminished. This investigation was undertaken to seek for any points of resemblance between this after-glow and the persistent meteor trains. These trains are masses of meteoric smoke left in the path of meteors, and are self-luminous, sometimes glowing for over thirty minutes. The luminosity appears to be electrical in origin. The height at which these trains occur is between fifty and sixty-five miles, and the after-glow bears a strong resemblance to them in a number of respects. The glow appears to be produced between definite gas pressures, which at the heights mentioned, were between 0.5 and 0.05 millimetre. The rate of diffusion of the after-glow at certain pressures is of the same order as the outward diffusion of the glowing particles of the meteor train, at the rate of several hundred per minute. The spectrum of both appear to be composed of a few lines or narrow bands. Under certain conditions the after-glow dies out first where it is formed, and observations have shown that many meteor trains fade first in the centre. The fact that the after-glow can occur at low temperatures shows that it is possible for such an effect to be produced at those temperatures which must exist at fifty or sixty miles above the earth's surface.—*Abstracted from the Physical Review (Lancaster), October.*

Some Observations on Alternating-Current Rectifiers.

An investigation of mechanical and electrolytic rectifiers has been made by A. C. Jolley. A machine of the permutator type, in which the rectified current is collected from a stationary commutator by synchronously rotated brushes, was first tested. This was rated at ten kilowatts and gave disappointing results. To obtain a charging current of twenty mean amperes the effective current indicated by an alternating instrument in the charging leads read fifty-one amperes, indicating a form factor of 2.55. The efficiency of the machine under these conditions was fifty-four per cent. This is five per cent lower than the efficiency which the machine gives on non-inductive load. To improve the performance, various inductances were placed in series with the battery. In this way the form factor was reduced until it was brought down eventually to 1.1, when the behavior of the machine was as good as on non-inductive load. An electrolytic rectifier of the Nodon type, designed to give an output of 500 watts, was found on test to give an efficiency at full load of seventy-three per cent. This was at 100 volts direct current, five amperes. The alternating voltage was about 136. The machine was capable of considerable overloads without a great reduction in efficiency; in fact, the efficiency curve represents that of a large generator. The efficiency is but little affected by heating until the temperature of the electrolyte has reached forty degrees centigrade, which, with this device, took place after a full-load run of two hours. At this point the primary current rises rapidly and the efficiency falls off correspondingly. By varying the voltage of the supply it is found that the efficiency of the device increased until it reached sixty-eight per cent at 135 volts, the direct-current load during the test being maintained constant at 500 watts. Changes in frequency had but little effect between the limits of forty and 200 cycles per second. The tendency is to lower the efficiency as the frequency rises. The whole effect at the highest frequency mentioned is about three per cent. The introduction of inductance does not influence the form factor when charging storage batteries.—*Abstracted from the Electrician (London), October* 12.

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY CHARLES NATHAN JACKSON.

I have always lived in the small city of "C," a town of about 30,000 inhabitants, in central Ohio. I have been in the banking business for several years and was interested, to a certain extent, in our local electric light plant. In course of time, however, I purchased the entire property. The former officers of the company had always been satisfied to let well enough alone and, as the plant was paying a small dividend, they were not very aggressive. I determined to see if, by increasing the business, I could increase the net earnings of the property.

We had a total generating capacity of 600 kilowatts and did not do the municipal lighting. The revenue was about $30,000 per year, and the plant was loaded to its utmost capacity about five o'clock in the December afternoons. The manager in charge was a very capable operating man and had several years of experience at operating plants. He was drawing a salary of $2,000 per year, but did not seem to know much about hustling for business. When I asked him what we had better do to increase the revenue, he said: "Hire a solicitor and install more machinery." We finally secured a young man who had sold electricity in another town, and started him to work and then began to make plans for increasing the capacity of the plant. We were charging ten cents per kilowatt-hour and the young man had not been at work very long before he secured a contract for a wholesale house that would use about twenty-five arc lamps. He also got contracts for several factories, and I began to think that there was a good prospect of his building up quite a business. However, I did not see any increase in the receipts, but the manager told me to wait until next winter and all these new customers would then be using the light. Of course, we could not expect much in the summer, as they did not need it. Gas was selling at a dollar a thousand cubic feet, and a walk through the business district at night showed all the saloons, drug stores, restaurants and hotels using gas. Upon enquiry I found that the price of electric light to such consumers was about three times the cost of gas, and of course they could not afford to pay the difference. The solicitor's business soon began to drop off and in a few months his orders were very few and far between. He merely said that he had secured every customer that he could and could not possibly get any more.

In other cities I have seen the electric light company light all the saloons, drug stores and the like, and wondered why we could not do it. So I began to look around and see if I could not find a man who could get the business. One day, in answer to one of my letters, Mr. Johnson, a man of about thirty-five years, called to see me, and in answer to my question as to what he could do, he replied that he did not know, but that if I would give him a guide and a right to ask a few questions, he could soon tell me. I did so, and the next day he returned and said: "I find that you have loaded your plant down with 'short burners.' About the only revenue you get is on the peak in the winter. You asked me how I could increase your net profits, and I will say that I can increase your net profits from twenty to thirty thousand dollars per year and you need not purchase any more machinery." I replied that I did not see how that was possible, as we could not raise our prices. He said that he would *cut* them to some customers and *raise* undesirable ones; for example, "you have a commercial light and power load of 600 kilowatts on the peak, or a revenue of $50 per year per kilowatt demanded on the peak. Now there are a great many concerns, such as saloons, drug stores, restaurants, hotels and other 'long burners' that you ask to pay at your present ten-cent rate, $200 per year, per kilowatt demanded, which is much too high; imagine a drug store having forty sixteen-candle-power lamps, paying you $400 per year—their gas bills are not over $150 per year—but you will let a wholesale store, that closes at 5.30, burn forty sixteen-candle-power lamps and only pay you $50 per year, and they cost you nearly as much as the drug store. All of your fixed expenses are the same for both, but the drug store uses about 4,000 kilowatt-hours and the wholesale store 500 kilowatt-hours. As your coal bill is not over one-half cent per kilowatt-hour, you can see the drug store would cost for coal $20, the wholesale house $2.50. So you are either making a very large profit on one or losing a lot on the other."

I could readily see that this argument was correct, and asked him how he would go about it to produce results. He replied that the town was not large enough for him to spend his entire time with us, but that he had in training several bright salesmen, any one of whom was capable of going into the town and working up the business under his supervision. Of course, it would oftentimes be necessary for him to help the solicitor on some big contract, and that he would charge me $1,800 per year for the services of the solicitor and for his own services he would ask twenty-five per cent of the increased profits during the first two years. After that he would probably not be needed, as things would be running so nicely that the solicitor would be able to go it alone.

His desire to back up his ability with such a proposition made me feel safe in accepting it at once. He at once came on the ground to give us a start and first got a friend of our company to agitate a rate ordinance, which was passed. It prohibited a charge in excess of fifty cents per month per sixteen-candle-power lamp to customers using light not over ten hours per day. The "long burners," of course, were pleased and boosted it along. The "short burners," never dreaming that it would affect them, said nothing. He then sent for the solicitor, who was instructed to charge a flat rate of $5 per month per kilowatt demanded, and an extra charge of two cents per kilowatt to all light customers, except residences, who were to pay ten cents per kilowatt-hour, $1 minimum. Lodge rooms, churches and hotels were to receive a special rate. The solicitor had no trouble in securing contracts with all the "long burners," and at the same time kept an eye open for unprofitable "short burners" and raised their price to the new rate. The whole-

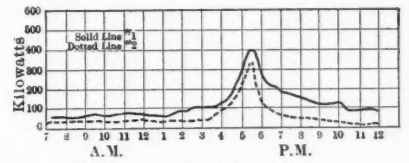
[1] This paper received an honorable mention in the contest inaugurated by the Cooperative Electrical Development Association, Cleveland, Ohio.

sale house, when asked to pay $10 per month plus two cents per kilowatt-hour, threw up their hands in horror and said that they would not stand for any such "holdup," so they put in gas.

In October the load curve of the station looked like Fig. 1. The load curve before looked like Fig. 2. He said, "You will notice that the load drops off a little after six, and if we don't do something we will have a curve like Fig. 3 in December. You will notice on Fig. 3 that it will begin to drop off at 5 P. M. I am going to start a strong campaign on residence lighting, churches and lodge rooms, which commence to burn at five o'clock and get heavier as the other load goes off."

He engaged two bright young fellows and started them after residence contracts at the old price of ten cents per kilowatt-hour. They would turn the names of all prospective customers over to a stenographer, who would mail them a series of letters and advertising matter on electricity for home use. In that manner they would get from two to four contracts per day. All that time the solicitor was getting all the churches and lodge rooms he could at a six-cent rate. It was not long before I could see a change in the load curve. It began to fill out after six, and by Christmas it looked like Fig. 4. He was not satisfied with that, but said he wanted one to look like Fig. 5, and that he would get it with power business. I replied that factories did not stop work until 5.30, so their load would be on the peak. He said that large factories are on the peak but small shops are not. He had studied their load and found that a load curve from a power circuit handling a great many large and small customers showed a load curve during December that began to drop off at four o'clock and reached zero at six, and at five o'clock it was only fifty per cent of the total load and that there were several large factories which he knew were on at five o'clock, consequently it must have been the small shops that began to quit at four o'clock and were practically all through at five.

He began to push power business at three cents to large and small customers alike. As there was no firm in town that handled motors, we sold them to our customers at cost. Such a low price on power secured a great many small power customers and a few large ones. He was gradually filling up the "valley" in the load curve, and our receipts in March were $5,000, which made me feel pretty good. About that time a big cold-storage plant was being built, and Johnson went after the business, quoting a two-cent rate. He told me that they would require 100 horse-power about 600 hours per year, which at two cents per kilowatt-hour would give us a revenue of $9,000, of which about seventy-five per cent was clear profit. I had so much confidence in Johnson that I knew he was right, but I had



FIGS. 1 AND 2.—LOAD CURVE.

to ask how the profit could be so much and how he could carry the increased load. "Nothing easier," he said. "They agree not to use power after 4 P. M. in November, December and January, so the only time they come near our full load is Saturday night in the summer time, and then our load is never more than 400 kilowatts. Regarding the seventy-five per cent profit, I am going to let you answer

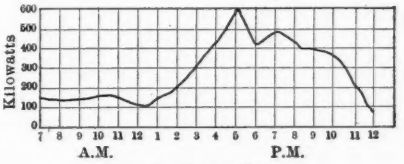
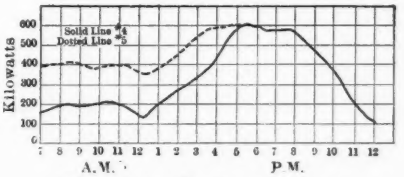


FIG. 3.—LOAD CURVE.

that. Do you have to put in any more machinery to carry the load?" I replied "No." "Do you require any more men to run your plant?" I said, "No." "Then isn't coal the only added expense, and does it cost you over one-half cent per kilowatt-hour?" I took off my hat to him. I could see his seventy-five per cent profit.

When summer came, our receipts held



FIGS. 4 AND 5.—LOAD CURVE.

up to about $4,000 per month. All the stores were paying their "flat rate." The power customers were paying more than they did in the winter, the refrigerating plant was paying us nearly $1,000 per month, and I began to see visions of a good paying property.

Johnson had an office system that was very thorough and yet very simple. He first bought one section (two drawers) of a vertical filing cabinet. The folders were numbered from "one" up. He had another drawer in which he kept his three-by-five-inch index cards. When a new contract came in, a work order was issued in quadruplicate (two heavy copies and two tissues), one tissue was put in the customer's folder, and the two heavy copies and the other tissue went to the operating manager, who kept the tissue and passed the two heavy copies to the line foreman and the meter foreman. The operating manager's tissue was kept on his desk so that he could see what orders were in the hands of the men. When the men returned their copies marked "completed," he destroyed his tissue and passed the orders back to Johnson, who passed them with the contract to the bookkeeper, who would enter the customer's name and rate on the ledger and then would pass them back to Johnson, who filed them in the customer's folder. He issued work orders for meter tests, complaints on service, etc., to the operating department in the same way, always filing his tissues at once, so at any time a glance in the folder would tell what the last move was. All prospective customers had a folder. After a visit, where anything of importance was said or done, he would dictate a "report" and file it. He also had a small desk tray, which he called the "tickler." One set of guides were for the twelve months and one set for thirty-one days. I have seen him dictate a report on a prospective customer, saying that "if Jones & Company renewed their lease December 1 they would be glad to accept our proposition of April 15." He would then drop a three-by-five-inch tickler card in the tickler for about December 1, calling attention to report of April 15 on Jones & Company. He never tried to remember the slightest thing regarding any deal. If it were "up to to the other party" he paid no attention to it and never gave it another thought. If it were "up to him" he would put in a tickler that would come up, say in ten days, asking if "Davis & Company had answered June 12," or, "had P. C. Stewart sent him plans as per May 29."

One day I asked him how a certain big power deal was progressing. He looked in the folder and found that the last thing done was a letter confirming a verbal quotation. It was signed by the solicitor, and we, to test the solicitor's system, looked in the tickler to see if he was taking care of it. We found a tickler

dated eight days from the date on the letter, asking if the Iron Works have answered May 17. He taught his solicitors never to use their memory, but to keep the system in first-class shape. He said that a good man could solicit at one time fifty large deals, whose business would run from $3,000 to $20,000 per year, and could tell any detail of any one of them in a very few minutes. After a call on a prospective customer, he should decide when he would call again, make his notes and then forget that such a deal is on.

There were about fifteen deals which he gave his personal attention in our town. I have seen him come into the office after a week's absence, look at a small memorandum book and say, "I must see Brown & Company this trip." I would ask him, "How about the others?" He knew no "others." He only knew those that turned up for that trip, and under no circumstances would he go near any other deal.

He trained his men *never* to say anything while on a deal until they got all the information they could, then to go away and "form a plan of campaign," and when they got a plan that looked good to them, "go ahead and work it."

At the end of the second year the results showed that our revenue was $62,000 per year, and about the only increase in operating expenses was for coal. I was very glad to pay him according to our agreement and insisted on retaining him at a salary of $1,200 per year in an advisory capacity only.

Our two largest hotels looked as dark and gloomy as they could, and the owners would not install any more lamps. The solicitor, by making a special rate for a few months, lighted one hotel until it made the other look like a dungeon. That made the owner of the "dungeon" sit up and take notice. As soon as the dungeon was well lighted and a contract was secured, the solicitor had no trouble in securing a contract with the other.

We made a special rate of three cents per kilowatt-hour, with a minimum of five cents per month per two-candle-power lamp, on signs, the customers agreeing not to light them before 5.30 P. M. As they came on after our five o'clock peak, our cost was only one-half cent per kilowatt. As the sign load would give us a revenue of nearly $60 per year per kilowatt, we considered it the best kind of business. Johnson showed me that if we charged six cents for sign lighting we would, as a rule, not get over $60 per kilowatt per year, and as they would light them at 4.30 P. M. during the holidays, and be on our peak, there would be no profit to speak of, while at the three-cent rate with the 5.30 P. M. start, it was nearly all profit.

The gas company, seeing their "long burners" leaving them, and in return getting our outcasts ("short-burners"), began a very aggressive campaign and offered all sorts of cut-rate propositions. Johnson told me to call upon their manager and tell him that if he did not quit that kind of warfare we would give him a "dig" that would hurt. You can imagine what that manager said to me. After I reported the result of my talk with the gas manager to Johnson, he said that we would advertise complete electric cooking outfits for $80 on time payments, and would sell current for them at two cents per kilowatt-hour. By advertising, we had no trouble in assuring the public that it was cheaper, cooler, cleaner and more healthful than gas, and we put out fifty sets in two weeks. The gas manager

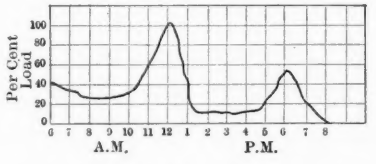


FIG. 6.—LOAD CURVE.

came to me and asked me how much longer we were going to run that offer. I replied "forever," and he went away declaring that we would go into bankruptcy if we continued at such a price. Johnson contended that we were making a good profit on it at two cents, as you see the cooking load runs like Fig 6. It is an all-day load until people begin to get their supper. The load at 5 P. M. is not worth considering, and it gradually gets heavier until after six. After we put in our new 500-kilowatt generator, we can not get enough residences to fill our load curve out from five to six, so the cooking load will fill in there very nicely and only increase our expenses a little for coal. The gas manager intimated that if we would put the price up to three cents, that he would quit cutting prices in the business district. But we were so strongly intrenched there that we thought we had better let the price remain at two cents as it was a great "ad" for us.

You asked me how to organize and conduct a commercial department, and, after my experience, can safely say, hire the best commercial man in the country and let him do the rest. Electrical engineers and mechanical engineers are absolutely necessary in building and operating your plant, but don't expect them to be commercial men any more than you would expect your architect to manage your factory, office, bank or department store if he should build it. So far the electric lighting industry has paid the high salaries to the engineers and has employed young inexperienced solicitors at salaries from forty to one hundred dollars per month, to market the product from an investment of sometimes millions. For that reason "good salesmen" have never cared to go into the electric business, and consequently to-day, when there is millions of business to be sold, there are very few men capable of selling it. Let me show you the difference between a "good man" and a "cheap man." You wish to develop a certain very thriving factory district, where you have to make a long run to reach it, and you must secure a certain amount of business to warrant the extension. Your "good man" secures seventy-five per cent of the business that he goes after; your "cheap man" thirty per cent. Your "good man" therefore makes it possible to make the run and thereby gives a big revenue from that district, while you get none from the "cheap man's" effort. Every man that you go after and "land" is an advertisement, because he, to show his good judgment, tells every one how nice and cheap electricity is, while the man that was solicited but not "landed" by the "cheap man" tells how *he* would not use it, as the price was too high.

I know of one case where a "cheap man," in talking to the manager of a foundry that was under construction, let the manager calculate that one crane, one cupola blower, three rattlers, one emery wheel and one small air-compressor for chipping, would, at a five-cent rate, cost him $8,000 per year. The manager proved to the "cheap man" that it would cost that much, and the manager was about to order his steam plant, when a "good man" heard of it and called to see him. When he heard the manager's story he merely said, "I know of a foundry where the conditions are identical, and, at a five-cent rate, they only pay about $3,000 per year. You put in your motors, but let the central station handle you for a few months, then, if your bills exceed that amount, and you still think you can save money by installing your own plant, do so." He got the business and kept it.

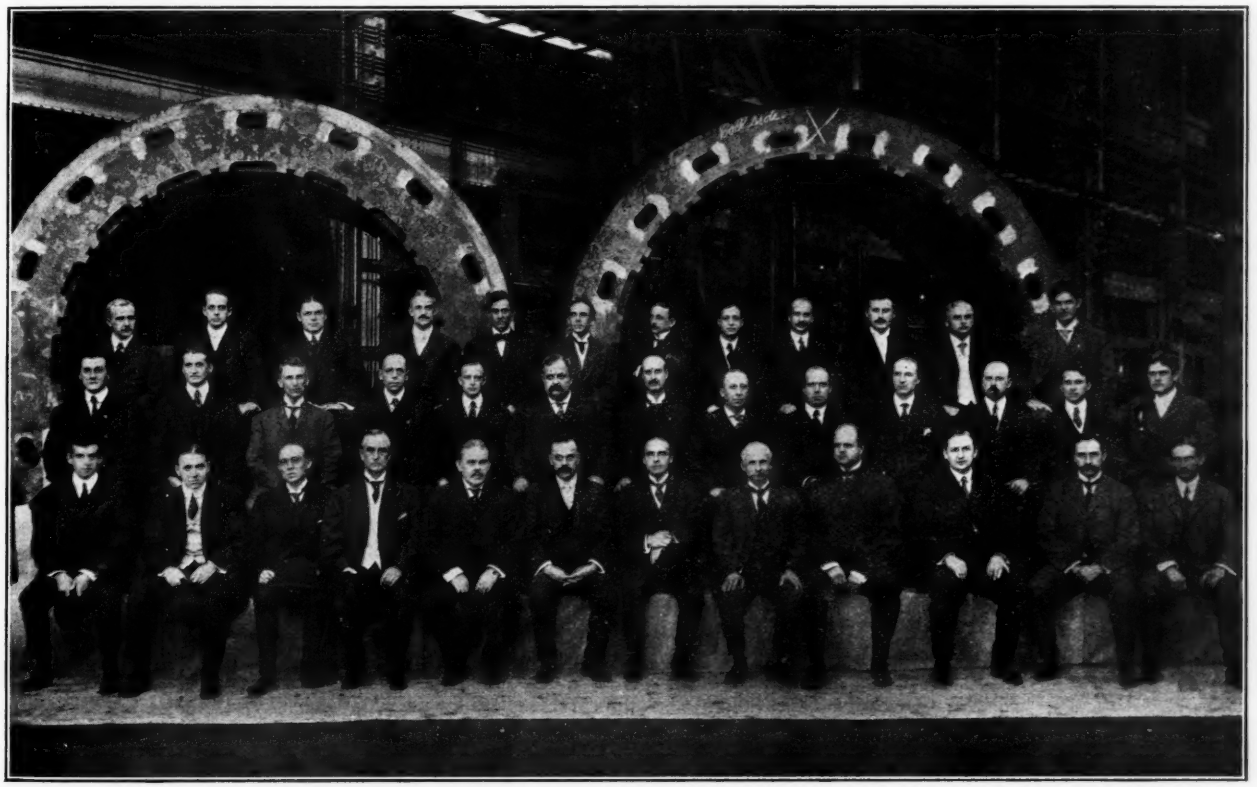
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Westinghouse Managers' Meeting.

The annual convention of the sales managers of the Westinghouse Electric and Manufacturing Company was held at the East Pittsburg works during the week ending October 27. The meetings were conducted by E. M. Herr, first vice-president, and L. A. Osborne, second vice-president, assisted by C. S. Cook, manager of the railway and lighting department; S. L. Nicholson, manager of the industrial and power department; C. B. Humphrey, manager of the detail and supply department, and Walter Cary, general manager of the Sawyer-Man Electric Company. On Wednesday evening, October 24, the officials of the company gave a banquet to the visiting managers at the Hotel Schenley, at which there were present, in addition to the officials and managers of the electric company, prominent officials of associated interests, including Colonel H. G. Prout, vice-president of the Union Switch and Signal Company; John F. Miller, fourth vice-president of the Westinghouse Air Brake Company, and E. H. Sniffin, third vice-president of the Westinghouse Machine Company.

These annual meetings of the Westinghouse company were inaugurated a number of years ago and give an opportunity for the mingling of ideas of the managers from all parts of the country, working under almost every known commercial condition. The convention closed on Saturday, when the managers returned to their respective territories.



GROUP OF WESTINGHOUSE SALES MANAGERS, EAST PITTSBURG, PA., MEETING, OCTOBER 22-27, 1906.

The Manufacture of Water-Wheel Governors.

The Lombard Governor Company, Ashland, Mass., has over an acre of machine-shop floor devoted to the manufacture of water-wheel governors. This company is now engaged in turning out a very large proportion of all the larger water-wheel governors used in this country. It has been increasing its factory from year to year, but at the present time it has about $60,000 worth of unfilled orders in the shops, and every effort is being made to make a gain in shipments each month.

From time to time it has been feared that the present era of activity in water-power plant construction would cease, but the prospects at the present time indicate even an increase in the rate of construction.

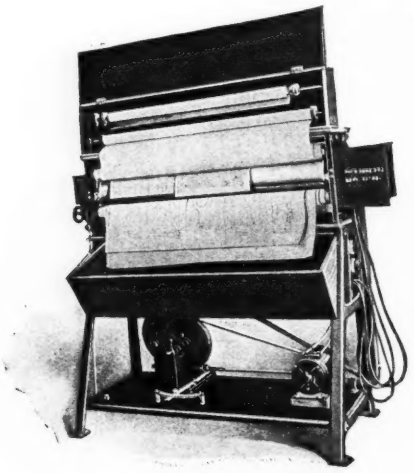
The president of the Lombard Governor Company is Homer Loring, of the banking firm of S. D. Loring & Son, Boston. Henry E. Warren is superintendent, and Allan V. Garratt is chief engineer and general sales agent, G. G. Beals acting as treasurer.

The company has well-organized offices in San Francisco, Seattle and Los Angeles, on the Pacific coast, and in Japan, and announces that Scandinavian Europe is also calling for a considerable supply of its apparatus.

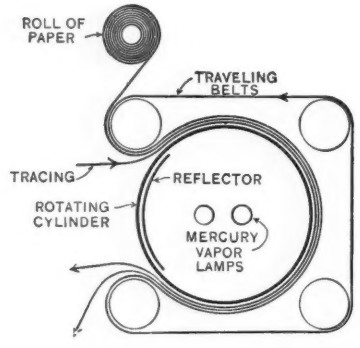
A New Form of Electric Blue-Printing Machine.

The accompanying illustrations show a new form of electric blue-printing machine placed on the market by the Revolute Machine Company, 523 West Forty-fifth street, New York city. This is designated as the Everett-McAdam continuous electric blue-printing machine.

This machine consists of a rotating glass cylinder which lies in a series of narrow belts. Within the cylinder are placed two Cooper Hewitt mercury-vapor electric lamps. The roll of paper to be printed is placed in a box on top of the machine and feeds in continuously between the belts and the cylinder; or, if only a few prints are wanted, previously cut sheets of paper may be fed in directly with the tracings. The tracings are inserted between the paper and the cylinder, and after passing around three-quarters of the circumference of the cylinder, are deposited with the paper in a box in the front of the machine, the printing being done from the inside of the cylinder as the paper and tracings travel around it.



Horizontal Electric Blue-Printing Machine.



Arrangement of Parts, Electric Blue-Printing Machine.

With this machine it is possible to make prints five feet wide and of any length whatever. The device is particularly adapted to making numbers of small prints on one long sheet of paper, or blue-print paper cut to the proper size to accommodate a number of small tracings can be fed in continuously. A feature of the machine is the facility with which the tracings may be fed in one at a time, small ones being fed in side by side, while the paper is fed automatically from a continuous roll. The tracings go in and come out on the same side of the machine, so that the leading edge of a tracing may be started into the machine again before the trailing edge comes out, saving considerable time where more than one print is wanted from a single tracing.

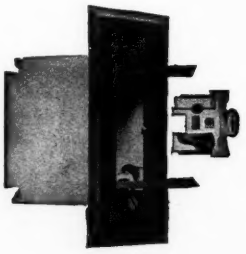
With the use of a number of one and one-half-inch belts, instead of a single broad contact belt, a uniform pressure is obtained, which is said to be decidedly advantageous.

Behind the lamps, and covering a section equivalent to about one-quarter of the circumference of the cylinder, is a reflector, which increases the printing power of the light furnished by the mercury-vapor tubes.

The machine is compact, requiring a space of two feet by five feet, and is entirely self-contained. The printing cylinder is driven by a motor, and the speed may be changed according to the time of printing desired for different qualities of paper.

New Type Flush Receptacle.

The Marshall Electric Manufacturing Company, Boston, Mass., has recently perfected and put upon the market a new plug and receptacle, known as its No. 971. This receptacle has the plug entirely enclosed in the receptacle, so that the finished article, whether with or without the plug, is flush with the plate, the two doors opening out each way permitting the withdrawal or insertion of the plug.



The contacts for wiring the receptacle are easy of access, yet well protected from the metal frames or boxes. The receptacle is arranged with the special Marshall lugs so that it is adapted for use in all standard conduit boxes or frames without any alteration or fitting. The receptacle is rated at ten amperes but carries safely a load of thirty amperes and the plug will take the reenforced cord.

These receptacles are carried in stock at the New York office, 227 Fulton street, and the Chicago office, 169 Adams street, of the Marshall Electric Manufacturing Company, as well as at the Boston works.

The Opening of the New Plant of the Wagner Electric Manufacturing Company.

On October 20 the Wagner Electric Manufacturing Company, St. Louis, Mo., formally introduced its new plant on Plymouth avenue, St. Louis, to its employés of all classes. Special cars were placed at the disposal of the working organization, and after luncheon was served at the plant the members of the party inspected the buildings and grounds at their leisure. In order that the arrangement of the new works might be easily understood, a descriptive pamphlet was provided, and the affair passed off very pleasantly, as every effort was made to indicate to the employés that in planning the development of the company the directors were not overlooking the general welfare of its working organization.

"G. I." Flush Receptacle and Attaching Plug.

The accompanying illustrations show the new form of flush receptacle and attaching plug placed on the market by the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass. Fig. 1 shows the front view of the receptacle with attaching plug inserted, and Fig. 2 the flush receptacle and attaching plug. The body of both receptacle and plug is made of porcelain proportioned to withstand severe usage. The face plate is made of heavy brass equipped with doors which close flush whether the plug is in or out of the receptacle. The doors are held either open or closed under tension by flat springs. The receptacle has flexible contacts of phosphor bronze, which adjust themselves to the fixed contacts on the plug and ensure good contact. The surfaces are kept clean by the rubbing of the contacts as the plug is inserted or withdrawn.

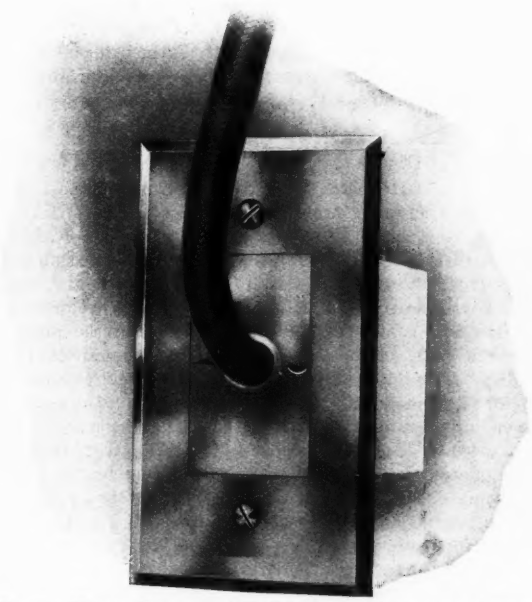


Fig. 1.—Front View of "G. I." Flush Receptacle with Attaching Plug Inserted.

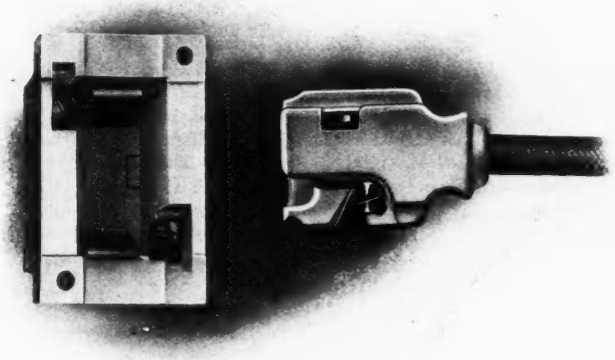


Fig. 2.—"G. I." Flush Receptacle and Attaching Plug.

This receptacle will fit standard boxes, and is designed with ample space for the wires. The plug is fuseless and the hole is seven-sixteenths of an inch in diameter, to take reenforced cord, and space for tying a knot is provided.

The plug contacts are copper and are kept in alignment by ribs formed on the plug. This eliminates the possibility of short-circuiting or grounding through the plate when inserting or withdrawing the plug, because the length of the plug contacts is less than the distance between the plate and the fixed contacts.

The Fifth National Business Show Held in New York City.

The Fifth National Business Show was held at Madison Square Garden, New York city, October 27 to November 3. Among the large number of companies making a specialty of office appliances there were some who are well known in the electrical field. The latter made exhibits of a smaller line of apparatus than is usually seen at an electrical show. The interest in these devices, however, was keen, and the companies report many profitable enquiries.

The companies enumerated below made exhibits and were represented as follows:

Advertising Mirrorgraph Company, Brooklyn, N. Y.—Motorless flashing electric signs, flashers, glass signs, paper cut-out signs. Represented by W. D. V. Kelly, manager.

Crouse-Hinds Company, Syracuse, N.Y.—This company made an elaborate exhibit of the "Hawley" time-registering clock. By means of a very ingenious system of marking up time sheets a complete weekly register is obtained. Represented by W. D. Hawley, W. C. Blanding and H. B. Crouse.

Holtzer-Cabot Electric Company, Brookline, Mass.—Interior telephone apparatus and annunciators; small motors for special applications. Represented by E. F. McCobb and A. P. Waterman.

Oliver Manufacturing Company, Philadelphia, Pa.—Telephone specialties, including the "Equipoise" telephone bracket. Represented by Scofield & Company, New York city.

New York Beck Lamp Company, New York city—Flaming arc lamps. Represented by George R. Berger.

The Schmidt-Wilckes Electric Company, New York city. Intercommunicating telephones, latest type; two complete intercommunicating sets coupled up; four private-line telephones of both the receiver and bell-call types. Represented by F. L. Benzon.

Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Private-exchange telephone systems; intercommunicating systems for hotels, factories, etc., and a regular line of central energy telephones, all connected up, showing the apparatus in actual service. Represented by James O. Oliver, H. A. Jones and F. W. King.

The New York Telephone Company had a very attractive booth, which also served as a main exchange for the exhibitors in the Garden.

The Bates Machine Company, Brooklyn, N. Y., made an exhibit of automatic numbering and dating machines. Represented by B. B. Conard, M. W. Phillips, Walter Grobe and G. J. Soulsby.

Illuminating Engineering Society.

The November meeting of the Illuminating Engineering Society will be held at the Edison Auditorium, 44 West Twenty-seventh street, New York, at 8.15 P. M. on Friday, November 9. Papers will be read on: "Fixture Location in Residence Lighting," by F. N. Olcott; "Fixture Design and Location," by Major E. L. Zalinski; "Location of Lamps and Illuminating Efficiency," by Preston S. Millar.

Current Electrical News

DOMESTIC AND EXPORT.

MEXICAN LIGHT PLANTS SOLD—The Mexican Light and Power Company, a Canadian concern, which already owns the electric light plants and street railway system in Mexico City and Pueblo, has purchased the two electric light plants and street railway systems of the city of Guadalajara. The price paid for the property was more than $7,000,000.

LAKE CHELAN (WASH.) POWER COMPANY—The Lake Chelan Water Power Company, organized under Arizona laws, with $3,000,000 capital, has filed articles of incorporation. Its objects are to engage in general transportation, irrigation and mercantile business. The incorporators and officers are: James McMillan, of Minneapolis, president; Junius Bebee, of Wakefield, Mass., vice-president; Albert F. Helliwell, of Minneapolis, secretary and treasurer; Carrie E. McMillan and Charles F. Linnmayer, of Minneapolis. The chief place of business is Phœnix, Ariz. Branch offices are provided for at Chelan, Washington, Boston, Minneapolis and New York.

MISSOURI INTERURBAN LINE CHARTERED—Articles of incorporation have been filed with the secretary of state of South Dakota for a new railway company which will build a line in western Missouri. It is known as the Western Missouri Interurban Railway Company, with a capital of $3,000,000. The headquarters of the company will be at Sioux Falls, S. D., with an office at Clinton, Mo. The company's line will be operated by electricity or other power, and will extend from Odessa, Lafayette county, to Greenfield, Dade county, a distance of 125 miles, the line to pass through the counties of Lafayette, Johnson, Henry, St. Clair, Cedar and Dade. The incorporators are: D. J. Haugeberg, Allie W. Campbell, Frank S. Gray and George S. Halliday, of Clinton, Mo., with enough South Dakota incorporators to comply with the law.

TELEPHONE CONSOLIDATION—The United States Telephone Company, which is part of the Brailey syndicate, has taken over nine of the largest independent telephone companies in Ohio, besides securing the controlling interest in the Huron county telephone syndicate. The acquisition was effected through an exchange of securities. The following companies have been operating as subsidiary companies since June 1: the Columbiana Telephone Company, Findlay Home Telephone Company, Citizens' Telephone and Message Company, of Fostoria; the Lancaster Home Telephone Company, the Massillon, Mansfield, Youngstown, Zanesville & Stark County Telephone Company. The transaction involves an exchange of $1,461,800 of United States Telephone Company stock divided into $1,100,000 common and $361,800 preferred, besides numerous other securities.

NEW ELECTRIC LINE—The Madison & Fond du Lac Electric Railway Company has been incorporated to build a third-rail electric line between Madison and Fond du Lac. It is stated that eastern capital is behind the enterprise. A survey has been completed and the right of way is being sought. The road will be finished by October 1, 1907. The direct route between Madison and Fond du Lac will include Windsor, Columbus, Beaver Dam and Waupun. A line will also be built from Watertown and Fox Lake, crossing the main line at Beaver Dam, where the power-house will be located. The present capital is $150,000, which will eventually be increased to $3,000,000. The new road will shorten the distance between the two cities twenty-three miles. It will carry both passengers and freight, and through trains will maintain a speed of seventy miles an hour.

PLANS OF THE BOSTON-NEW YORK INTERURBAN—Details of the project for a new interurban line between Boston and Providence, to constitute a part of a Boston-Providence-New York line. have been filed with the railroad commissioners by the Boston & New York Electric Railroad Company, the company for which articles of association were advertised a few weeks ago. They show that the proposed line would be about thirty-five miles long, with its Boston terminus at Forest Hills. The company asks that the commissioners certify that public exigency requires the construction and operation of the proposed line, and a date for a hearing on the petition will be announced later. Charles C. Blaney is counsel for the new company, and the directors are: Stephen W. Reynolds, John F. Crocker, L. S. Brown, Daniel W. Howland and A. B. Leach. The company has filed a schedule of cost of building and equipment of its proposed line, of which the total is $7,115,250. The proposed route would involve forty overhead bridges, sixteen under bridges, four railroad bridges, sixty farm bridges and forty-one culverts, items in the preparation of a private right of way devoid of grade crossings.

ENGINEERING SOCIETY NOTE.

SCHENECTADY BRANCH OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The third meeting of the season of the Schenectady branch, American Institute of Electrical Engineers was held on Saturday evening, October 20. Dr. Rossiter W. Raymond was the speaker of the evening and presented an address on "Professional Ethics," a subject of great interest at present to all electrical engineers on account of President Wheeler's address at the Milwaukee convention of the Institute and the present activity on the part of the Institute's special committee recently appointed to formulate a code applicable to the electrical profession. Dr. Raymond was greeted by an enthusiastic audience of some seven hundred and the value of his remarks amply justified the large attendance. As president of the American Institute of Mining Engineers for several years, as the efficient secretary of that body for some twenty years and as editor for years of the *Engineering and Mining Journal*, which he founded, Dr. Raymond is particularly well equipped to speak with authority on the subject he chose. He addressed his remarks to the young engineers and students, speaking for loyalty to one's employer and to one's self, with a fund of anecdote and wit that seemed inexhaustible and kept the room in laughter between the serious portions of his talk. He gave much good advice and summed up with the following general rule of engineering ethics: "Do not do what you can not tell, or if there be a good reason for not telling the details, do not do what you can not tell without shame." The speakers were introduced by Chairman Rushmore, and among the others were Dr. George R. Lunn, of the First Reformed Church; Dr. W. R. Whitney, of the research laboratory, General Electric Company, and Professor Hoffman, of Union University. The branch meetings are held in the auditorium of the Schenectady High School, and the officers of the branch are greatly gratified by the continual increase in the size of the audience. Although the admission was by ticket only at this meeting, the attendance was the largest in the history of the branch. An interesting feature of the meeting was the large number of men who came prepared to join the branch. The membership committee has succeeded in building up a branch membership which already is more than three times the number of regular members and associates of the national body residing in Schenectady. At the same time, however, the local membership of the parent organization has been greatly increased on account of the activity of Institute work at Schenectady. Weekly meetings are being held through the winter. On Friday, October 5, the branch was addressed by T. Commerford Martin on "Technical Journalism," and on October 12 by E. G. Acheson on "Inventions and Discoveries."

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Milwaukee, Wis., January 16, 1907.

American Society of Mechanical Engineers. New York city, December 4-7.

NEW INCORPORATIONS.

AUSTIN, TEX.—Jacksonville Ice and Electric Company, Jacksonville. $75,000. Incorporators: Charles A. Zilker, William Watkin and L. H. Vanderwerf.

COLUMBUS, OHIO—Massillon Northern Railway Company, Massillon. $10,000. Incorporators: W. O. Schuster, H. W. Loeffler, C. F. Dow, L. A. Koons and G. W. Kratsch.

AUSTIN, TEX.—Citizens' Light and Power Company, Texarkana. $50,000. Incorporators: C. C. Taylor, Robert E. Miller, John B. King, Claude L. Shepherd and R. W. Rodgers, all of Texarkana, Tex.

WICHITA FALLS, TEX.—Citizens' Light and Power Company, Wichita Falls. $10,000. Incorporators: E. P. Walsh, G. W. Wigham, J. D. Davis, W. E. Skeen, A. Kahn, Edward Howard and T. F. Taylor, all of Wichita Falls.

DES MOINES, IOWA—American Electric Railway Company. To build an electric road from Omaha to Chicago, to pass through Winterset and Des Moines. $20,000. C. W. Baker, president; J. D. Pollard, vice-president, and Charles F. Castleman, secretary.

AUGUSTA, ME.—Gennessee County Niagara Power Company, organized at Portland, for the purpose of promoting or carrying on the business of an electric light and power company. $250,000. Officers: president, W. F. Crummett, of Portland; treasurer, Charles D. Fullerton, of Portland.

LANCASTER, PA.—Leland Electric Light Company; to supply electric light and power to the residents of Manheim borough; $5,000; directors: J. Hector McNeal, H. C. Case, George R. Heisey, E. L. Baker and L. M. Endebrock. Stover Electric Light Company; $5,000; same directors as above; incorporated to furnish electric light and power to Mount Joy borough.

HARRISBURG, PA.—Sylvan Avenue Street Railway Company, Pittsburg; $21,000. Haight's Street Railway Company, Pittsburg; $15,000. Winebiddle Street Railway Company, Pittsburg; $6,000. Halkett Street Railway Company, Pittsburg; $3,000. Coral Street Railway Company, Pittsburg; $6,000. Greenwood Street Railway Company, Pittsburg; $7,500. Frankstown Avenue Street Railway Company, Pittsburg; $3,000. Glenwood Avenue Street Railway Company, Pittsburg; $6,000. Hale Street Railway Company, Pittsburg; $6,000. Johnstown Avenue Street Railway Company, Pittsburg; $6,000. Portland Street Railway Company, Pittsburg; $13,500. Harriett Street Railway Company, Pittsburg; $6,000. Moulton J. Hosack, Pittsburg, is president of all these companies.

NEW MANUFACTURING COMPANIES.

DOVER, DEL.—Articles of incorporation have been filed for the Electric Supply Company, of Maryland, to transact a business of wholesale and retail electric supplies, etc. The incorporators are: George M. Upshur, Franklin Upshur, Sherwood R. Murphy and John M. Newverth, Jr. The capital stock is $5,000.

ATLANTA, GA.—E. F. Peckham, H. E. Tolman, A. Madison, W. J. Fletcher and J. H. Tolman have filed an application for a charter for the Current Motor Company, of Georgia. The company will be capitalized at $1,000,000, with the privilege of increasing the amount. It is proposed to deal in electrical appliances and to equip and operate power and light plants.

PASSAIC, N. J.—Articles of incorporation have been filed of the R. B. Anderson Company, electrical contractor and engineer, of Passaic. The incorporators are: Reginald B. Anderson and H. Anderson, Zabriskie A. Van Houten and A. G. Van Houten. The capital of the concern is $15,000, and the business will be conducted from Mr. Anderson's present quarters in the People's Bank Building.

NEW PUBLICATIONS.

A NEW POTENTIOMETER—A recent paper on "A New Potentiometer for the Measurement of Electromotive Force and Current," contributed to the *Bulletin of the Bureau of Standards* by H. B. Brooks, has been reprinted in pamphlet form. This describes a new design of potentiometer which is thought to have some useful advantages for certain kinds of work.

THE ELECTRICAL PLANT OF THE ONTARIO POWER COMPANY—The Ontario Power Company, Niagara Falls, Ontario, has published, in handsome pamphlet form, the paper entitled "The Electrical Plant of the Ontario Power Company," by V. G. Converse, which was presented at the sixteenth annual convention of the Canadian Electrical Association at Niagara Falls, Ontario, June 19, 1906.

ELECTRICAL SECURITIES.

As compared with a week ago the active list of industrials shows an improvement, with considerable advances in some cases. Despite this advance, however, traders generally are viewing things from a bearish standpoint, and it is expected that until after the general elections there will be but little change either way. It is hoped that by that time there will also be a loosening of money, so that a number of important deals which are about to be launched may have the assistance of an easier money market.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 27.

New York:	*Closing.*
Allis-Chalmers common	17⅛
Allis-Chalmers preferred	44¾
Brooklyn Rapid Transit	78⅝
Consolidated Gas	138½
General Electric	173½
Interborough-Metropolitan common	36⅝
Interborough-Metropolitan preferred	76¼
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	70
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	142
Metropolitan Street Railway	104
New York & New Jersey Telephone	124
Western Union	86
Westinghouse Manufacturing Company	156

Directors of the Consolidated Gas Company have declared the regular dividend of 1 per cent. The dividend is payable December 15. Books close November 26 and reopen December 17.

Notwithstanding the entrance into its comparatively dull season, earnings of the Brooklyn Rapid Transit system continue to show substantial gains over those of last year.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	233
Massachusetts Electric	69
New England Telephone	129
Western Telephone and Telegraph preferred.	80

Directors of the New England Telephone and Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable November 15. Books closed October 31 and will reopen November 15.

Coupons from the five-per-cent three-year gold coupon notes of the American Telephone and Telegraph Company, by their terms payable on November 1, 1906, at the office of the treasurer in the city of New York, or, at the holder's option, at the office of the treasurer in the city of Boston, will be paid in New York by the Manhattan Trust Company, 20 Wall street, or in Boston by the National Bank of Commerce, Sears Building.

Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	71
Electric Storage Battery preferred	71
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	27⅞
United Gas Improvement	91⅛

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	148
Metropolitan Elevated preferred	66½
National Carbon common	87
National Carbon preferred	119
Union Traction common	—
Union Traction preferred	—

PERSONAL MENTION.

MR. F. BISSELL, president of the F. Bissell Company, Toledo, Ohio, was a New York visitor last week.

MR. F. M. HENCKEL, of the Bryan-Marsh Company, Chicago, Ill., reports a new heir to the "House of Henckel."

MR. L. P. SAWYER, manager of the Buckeye Electric Company, Cleveland, Ohio, was a New York visitor last week.

MR. CHARLES PHILLIPS HILL, of the Doubleday-Hill Electric Company, Pittsburg, Pa., was a New York visitor last week.

MR. R. K. MICKEY, president of the Novelty Incandescent Lamp Company, Emporium, Pa., spent several days at the Imperial Hotel, New York city, during the last week. Mr. Mickey was accompanied by Mrs. Mickey.

MR. JAMES JARDINE, of Sacramento, Cal., has been appointed master mechanic of the Northern Electric Railroad Company, with headquarters at Chico, Cal. Mr. Jardine was formerly government inspector at the Union Iron Works, San Francisco.

MR. JOHN E. McGIVNEY, purchasing agent of the New Orleans Railway and Light Company, who attended the street railway convention at Columbus, Ohio, spent several days in New York and Boston before returning to New Orleans. His new friends in both cities were very glad to welcome him.

AMONG other New York visitors last week were John W. Brooks, sales manager of Pass & Seymour, Syracuse, New York; William Robertson, president of the Robertson Electric Company, Buffalo, N. Y., accompanied by Mrs. Robertson, and J. M. S. Fullman, manager Steel City Electric Company, of Pittsburg, Pa.

MR. E. J. KULAS, secretary and manager of the Brilliant Electric Company, and vice-president of the A. & W. Electric Sign Company, was a visitor to New York city last week. Mr. Kulas reports a very heavy demand for the new high-efficiency lamps which this company is making and expects the busy season to last for some time.

MR. F. R. M. EVANS has been appointed special representative on tantalum, "Gem Meridian," "Gem" high-efficiency and "Gem" standard lamps for the Buckeye Electric Company, Cleveland, Ohio. Mr. Evans has had a unique technical experience in laboratory and research work on these lamps, and his engineering ability will be of great value to him in the sales organization of this company.

MR. MARSDEN J. PERRY, president and general manager of the Narragansett Electric Lighting Company, Providence, R. I., and past-president of the National Electric Light Association and one of the most prominent central station managers in the country, was a visitor to New York city last week. Mr. Perry was in his usual good spirits and was kept busy looking up old acquaintances.

MR. R. C. MARDEN has been appointed district superintendent of the Fitchburg (Mass.) district of the New England Telephone and Telegraph Company. Mr. Marden entered the New England Company's service as night operator at Claremont, N. H., in 1894. The three years following he was engaged in operating, inspection and line work and then became chief clerk and cashier of the company's northern division, with headquarters at Burlington, Vt. From Burlington Mr. Marden was transferred to Lowell, Mass., where for the past six years he has been chief clerk.

MR. JOHN W. DAVIS, who has been manager of the offices of the Western Union Telegraph Company and the Pacific Express Company at Independence, Mo., for about twenty-seven years, and also of the Bell Telephone Company since its establishment in Independence, has sent in his resignation to the telegraph and express companies. He does this in order to devote his entire time to the Missouri & Kansas telephone system. Mr. Davis has charge of the business of this company between Kansas City and Odessa. Mr. Davis first came to Independence in 1879 as night operator for the Chicago & Alton Railway, which had just been built through the city.

MR. C. W. HUTTON, formerly superintendent of the electric department of the Sacramento Electric, Gas and Railway Company, has been made superintendent of the Sacramento division of the California Gas and Electric Corporation, with headquarters at Sacramento, Cal. He will have jurisdiction over the Alta, Auburn and Newcastle power-houses and the substations and transmission lines of the Central California Electric Company, the Folsom power-house, the transmission lines and the Sacramento substation of the Sacramento Electric, Gas and Railway Company, and a portion of the Bay Counties Power Companies' transmission lines and substations between Davis and Lincoln. C. R. Gill, formerly Mr. Hutton's assistant in the handling of the Sacramento electric department, is promoted to the position of superintendent of electric distribution, and will have charge of all of the distributing lines of the company in the city of Sacramento. Mr. Hutton will act in an advisory capacity in connection with the distribution.

MR. C. A. S. HOWLETT, formerly a contracting engineer for the Western Electric Company, Chicago, Ill., has been appointed manager of the power-apparatus sales department of the Chicago office, succeeding Alfred McEwen, resigned. Mr. Howlett is well-known in the electrical engineering field in the Middle West. His technical training was obtained at the Lawrence Scientific School, Harvard University. After graduation he obtained a practical experience in the Lynn shops of the General Electric Company, later entering actively into commercial engineering work. He is a member of the American Institute of Electrical Engineers, the Western Society of Engineers, the Illuminating Engineering Society, is chairman of the General Advancement Committee of the Electrical Salesmen's Association, and secretary of the Chicago division of the Rejuvenated Sons of Jove.

MR. JOSEPH B. BAKER has been appointed technical editor of the government fuel testing plant, with headquarters at St. Louis, Mo. Mr. Baker for the past two and one-half years has been a technical writer under M. P. Rice, manager of the publication bureau of the General Electric Company, at Schenectady, N. Y. He may be considered as one of the best endowed of technical writers, as his skill is the result of fifteen years of practical engineering work, the contributing of numerous articles to the technical and daily press, as well as the teaching of classes in electricity and delivering lectures on special subjects at the Massachusetts Institute of Technology and at Harvard and Union Universities. His engineering training has been a broad one, comprising experience in the installation of electric light plants, experimental work, general telephone engineering, machine design and consulting engineering. This training, crowned by the technical publicity work which Mr. Baker has been doing for the General Electric Company, thoroughly equips him for similar work for the United States government.

TELEPHONE AND TELEGRAPH.

SPRINGFIELD, MASS.—A telephone line has been completed in Cheshire.

LINDSAY, ONTARIO—The Lindsay town council has passed a by-law granting a twenty-one-year franchise to the Canadian Machine Telephone Company, of Toronto.

NEW LONDON, CT.—Considerable new conduit work for the underground cables of the Southern New England Telephone Company will be undertaken in New London this fall. A new exchange has been opened in Colchester. This will give the Southern New England a total of 534 exchanges in Connecticut.

TRAVERSE CITY, MICH.—The farmers on the peninsula have organized a telephone company and already have five miles of line in service. The whole of the peninsula is included in the territory, and the line is connected with the Michigan State Telephone Company. The officers are as follows: president, H. E. DeGraw; secretary and treasurer, P. F. Lardie.

AUGUSTA, ME.—The Maine Telephone Company, which recently purchased the Crosby lines, has rebuilt many of the old lines and has also built new ones in this vicinity. The long-distance service now furnished is excellent. The Mount Vernon Telephone Company, a local company which was organized last year, has also been extending its lines, and now has 230 subscribers in Mount Vernon and vicinity.

LOS ANGELES, CAL.—Extensive local improvements are being planned by the Sunset Telephone Company. Arrangements are being made to string many miles of new wire and increase the switchboard capacity at both the central and branch offices. Work on the enlargement of the system will probably begin in the near future. Although no figures have been mentioned it is thought fully $1,000,000 will be expended. The company now has about 29,000 subscribers. A new fireproof building is being erected on Boyle Heights in which a switchboard will be placed to facilitate the service to that part of the city.

ELECTRIC RAILWAYS.

PROVIDENCE, R. I.—The Old Colony Street Railway Company's new through service between Providence and Boston has been inaugurated.

DANBURY, CT.—The Danbury & Bethel Street Railway Company has begun the work of laying tracks for a two-mile extension of the local street railway system.

TAYLORVILLE, ILL.—The city council of Taylorville has decided to grant the Springfield-Pana Interurban Company a franchise through the city, with concessions which are to be arranged later.

ALBANY, N. Y.—It is stated that the deal for the transfer of the control of the United Traction Company, of Albany, to the Delaware & Hudson Company has been closed by the turning over of forty shares of stock to the latter.

COLUMBUS, IND.—Negotiations have been closed by the Columbus Street Railway and Light Company for the building of a new power plant south of the city, which, with its equipment, will cost $100,000.

EAST DOUGLAS, MASS. — The selectmen of Douglas have signed the grant that gives the Worcester & Providence Street Railway Company the right to build a double-track road in the village of East Douglas.

SAN FRANCISCO, CAL.—The Peninsula Railway Company has begun the work of constructing its line from Mayfield to Los Gatos, and it is believed that the road will be ready for business within eight months.

DETROIT, MICH.—Work on the Windsor & Tecumseh electric railway, the franchises and rights of way of which recently passed into the hands of the Detroit United Railways, will be commenced in a short time by the new owner.

BEAUMONT, TEX. — The construction of an electric railway between Beaumont and Port Arthur *via* Spindle Top, Port Neches and Nederland is now assured, a franchise having been granted the promoters of the road by the county commissioners' court.

HOLLIDAYSBURG, PA.—Arrangements have been made for building the Johnstown, Ebensburg & Northern Electric Railway. The first division from Johnstown to Ebensburg, twenty-five miles long, will be built at a cost of $500,000 by the Endelbel Construction Company, of New York. The road, it is reported, will later be extended to Hollidaysburg and Altoona.

DOYLESTOWN, PA.—The Newtown Electric Street Railway Company, which controls the road between Doylestown and Newtown, reorganized by electing Thomas P. Chambers president, and Alexander Chambers, A. W. Watson, George C. Worstall, T. S. Enderdine, E. H. Buckman, all of Newtown, and H. E. Woodman, of Philadelphia, directors.

SYRACUSE, N. Y.—Announcement is made that the contract for grading the proposed extension of the Syracuse, Lake Shore & Northern Electric road from Baldwinsville to Fulton, a distance of fifteen miles, including the foundations for the bridges, has been awarded by the Beebe syndicate of electric roads to the firm of C. E. & J. S. Kaulbach, of Phœnix.

WATERBURY, CT.—At a recent meeting of the directors of the Woodbury & Waterbury Street Railway Company it was decided to build the new trolley line to Lake Quassapaug as soon as possible. At the same meeting it was decided to merge the Woodbury & Waterbury company and the Seymour & Woodbury company and to operate them under one management.

MONMOUTH, ILL.—At a meeting of the Rock Island Southern interurban officials and St. Louis and New York capitalists, one and a quarter million dollars was secured to extend the line from Monmouth to Rock Island. Surveying parties will commence work at once and the route be determined. Contracts for construction also will be let and the line completed within a year.

FARMINGTON, MO. — The St. Francois County Court has granted franchises to two electric railroads, which propose to give the lead belt an outlet to St. Louis. The railway companies are the St. Louis, Montesano & Southern, of which Charles A. Gutke, of St. Louis, is president, and the St. Louis & Southeastern, of which O. M. Munroe, of De Soto, is president. The former company is capitalized at $4,000,000, and the Southeastern at $250,000.

ALBANY, N. Y.—Paul Smith's Electric Light and Power and Railroad Company has asked the state commission on gas and electricity for permission to issue $5,000 of bonds and to increase its capital from $75,000 to $100,000. The funds are needed to complete the company's railroad. The Saranac Lake Light, Heat and Power Company has requested permission to sell its property and franchise to the Paul Smith's company.

WAYNESVILLE, MO.—J. J. Burns, of St. Louis, is organizing a stock company to build an electric road connecting Waynesville with the 'Frisco system at Crocker. He proposes to organize, with a capital stock of $15,000 per mile, the citizens to purchase $20,000 stock; the remainder will be bought by eastern capitalists. This road will eventually be built from Eldon to Mountain Grove, Mo., and will furnish transportation facilities for the most fertile region of the Ozarks.

ROMNEY, W. VA.—The Petersburg district in Grant county and the South Fork and Moorefield districts in Hardy county will vote at the regular election in November on the proposition to subscribe for $20,000 worth of the bonds of the proposed Hampshire Southern Railway Company, which proposes to build a line from Romney to Petersburg, the line for which has already been laid out. It is also proposed to exempt the bonds from interest payment for a period of ten years, in order to encourage the new road.

NEW HAVEN, CT.—The Connecticut Railway and Lighting Company will at once begin the work of connecting its trolley line, which is now being built down the eastern side of the Naugatuck river, from Naugatuck to Seymour, with the present tracks of the Connecticut Railway and Lighting Company at the south. When this work is completed, which will be in good season next year, the Connecticut Railway and Lighting Company will have uninterrupted trolley lines from Waterbury to Bridgeport and thence to beyond Stamford on the southwest, paralleling the steam lines of the New York, New Haven & Hartford Railroad Company.

WILKESBARRE, PA.—At a meeting of the officials of the Wilkesbarre & Wyoming Valley Traction Company it was decided to apply to the court for the privilege to construct two new lines. One of the lines will be known as the Pittston & Avoca Street Railway Company and will operate between the two towns, passing through Hughestown. The other road will start from the present terminus of the East End line and will extend through Parsons, Miners Mills and Hudson, connecting with the present Plains line at Miners Mills. This will be known as the Wilkesbarre & Plains Railway Company. An extension will also be made to the Sugar Notch and Georgetown lines as soon as the new road is completed. The new improvements will cost over $500,000.

LIMA, OHIO—The building of the trolley link between Sandusky and Fremont is being rapidly pushed forward by the Lake Shore Electric, and the Western Ohio has entered into contracts for the construction, early in the spring, of the connecting link between Fremont and Fostoria, which, when completed, will parallel the Lake Erie & Western road from Celina to Sandusky. The Schoepf-Morgan branch, known as the Indiana Union Traction Company, has made complete surveys for the building of a link between Celina and Portland, Ind., in the spring. By this road this city will have an air line by trolley to Indianapolis, also Toledo and Detroit. With the Fremont-Fostoria link, Cleveland and Lima will be given through trolley service, there being no direct steam line from Lima or northwestern Ohio.

TOLEDO, OHIO—Arrangements have been completed by the Toledo & Indiana Railway Company for the extension of its lines westward from Bryan, which will fill the last gap in the continuous system of trolley lines between Chicago and Erie, Pa. It is expected the gap, which extends from Bryan to Waterloo, a distance of twenty-five miles, will be closed by the new trolley by the end of 1907, making a continuous line from Toledo to Chicago. From Toledo eastward there is a chain of trolley roads, including the Lake Shore Electric to Cleveland, and the Cleveland, Painesville & Eastern, from Cleveland to Erie, Pa. A new line is now being constructed from Erie to Buffalo. When this line and the line between Bryan and Waterloo are completed, a continuous trolley system will exist between Buffalo and Chicago.

ELECTRIC LIGHTING.

OTSEGO, N. Y.—A franchise has been granted for an electric lighting system.

PROVO, UTAH—The citizens of Provo have voted against the proposition to buy the electric light plant.

ST. CHARLES, MO.—It has been decided by the city council to buy new equipment for the electric light system.

ST. JOHNSVILLE, N. Y.—At a meeting of the village board a franchise was granted to the Hudson River Electric Power Company.

ST. AUGUSTINE, FLA.—The South Beach Bridge and Railway plant has been transferred to the St. Johns Light and Power Company.

NIAGARA FALLS, N. Y.—The Niagara, Lockport & Ontario Power Company has been granted a power franchise to do business in Lancaster.

LOS ANGELES, CAL.—Los Angeles capitalists are said to be behind a new scheme for a power plant in Fresno county, on which they propose to expend $200,000.

GUTHRIE, OKLA.—Reynolds & Tucker, of Tulsa, have been granted a franchise to put in a $20,000 electric light plant at Sapulpa, and work on it will begin soon.

LOS ANGELES, CAL.—The city council and the board of public works have agreed to install 200 new street lights, one-half that number in January next and the balance during the spring months.

PORTLAND, ME.—The Portland General Electric Company is completing its new power and distributing station on Knott street. It is 100 by 50 feet, and with its machinery will cost upward of $40,000.

GREELEY, COL.—Tax payers have voted by a large majority in favor of granting the Greeley Gas and Electric Company a franchise. The company will now issue bonds, enlarge its plant and build a new power-house. About $40,000 will be expended.

ELYRIA, OHIO—The city council has granted to the Elyria Milling and Power Company a franchise to use the streets and alleys of the city for the purpose of erecting poles, stringing wires and the operation of an electric lighting plant in Greater Elyria.

FREDERICKSBURG, VA.—The Fredericksburg Water Power Company, owned by Joseph F. Swift, of Wilmington, Del., has been sold to a party of capitalists, represented by W. C. Whitney, of Rock Hill, S. C. The price is said to have been $125,000.

BOSTON, MASS.—The Pittsfield Electric Company has petitioned the gas commissioners to increase its capital stock from $150,000 to $225,000 and its bonded debt from $100,000 to $150,000. The proceeds are to be applied to the completion of a new power-plant and other additions.

BLACKSBURG, VA.—The Blacksburg Power and Supply Company has placed an order for the first instalment of machinery for its plant. This company was organized in September, with D. H. Keister, president; J. F. Evans, vice-president; M. F. Slusser, secretary and treasurer.

COBOURG, ONTARIO—A special meeting of shareholders for reorganization of the Northumberland-Durham Power Company was held recently. Twenty-one directors were elected from Cobourg, Port Hope, Colbourne, Campbellford and Belleville. J. A. Culverwell was elected president.

SALEM, OHIO—The Ford Lighting Company, now located in Elyria, has been purchased by a newly incorporated company of local business men and will be transferred to Salem in the near future. The new company is incorporated with a capital of $30,000, all the stock being held in Salem.

PEABODY, MASS.—The lighting committee appointed to investigate the municipal electric lighting plant problem has returned its report, which will be brought before the town at its next meeting. The committee comes to no definite conclusion, but rather favors the purchasing of current in preference to rebuilding the town plant. The committee fully endorses the report of the Electrical Auditing Company, Boston, Mass., which suggests the alternative proposition of either manufacturing or purchasing current. This report made a close analysis of the situation and pointed out the conditions under which the town might profitably purchase its current from a private corporation.

BRIDGEHAMPTON, N. Y.—The Babylon Electric Light Company is contemplating installing an all-day service, having facilities for power as well as lights. The capital stock of the company will be increased from $15,000 to $75,000. A modern fireproof building is to be erected to accommodate the new plant.

ASHTABULA, OHIO—The Merchants' Lighting Company has been incorporated for the purpose of establishing in this city a new electric light plant. The project is due to the inability of the present municipal plant to supply the demand for lighting, and to the refusal of the council to make needed additions. The movement is supported by the merchants of the city, and has ample financial backing.

SYRACUSE, N. Y.—The Niagara, Lockport & Ontario Power Company, which furnishes electricity for the running of the cars of the Syracuse Rapid Transit Company, has completed its duplicate line nearly to Rochester, and will continue work until it reaches the city line at Syracuse. This system, it is expected, will enable the company to deliver power without interruption, which it has not been able to do up to the present time.

WILKESBARRE, PA.—A meeting of the stockholders of the American Electric Light Company and the American Gas Light Company, of Bloomsburg, has been held and the companies merged into one. Officers were then elected as follows: president, E. B. Tustin; vice-president, J. B. Russell; secretary and treasurer, A. W. Duy. The above and P. R. Bevan and G. W. Reynolds, of Wilkesbarre, and H. S. Barton, of Bloomsburg, were elected as directors. A name for the new company will be decided on later.

ESSEX JUNCTION, VT.—A deal has been closed whereby the extensive water power on the Winooski river at Essex Junction has been sold to the Consolidated Electric Company, of which F. H. Parker, of Burlington, is superintendent. This deal includes the Hunter, Shiland and Johnson dam, the water power owned by C. W. and S. A. Brownell, the grist mill and creamery owned by W. B. Johnson & Company and the sawmill owned by S. A. Brownell. This power will be developed at an estimated cost of $250,000.

WESTERVILLE, OHIO—After defeating municipal ownership last year, Westerville has reconsidered it, and by a majority vote passed a proposition to issue $12,000 in bonds for the purpose of purchasing the franchise and plant of the Westerville Electric Company. The plant will be enlarged and improved for the purpose of supplying electric lights to the corporation and inhabitants. The question of municipal ownership has been agitated for some time, and prior to the voting, a mass meeting was held, at which the matter was thoroughly discussed.

SUMAS, WASH.—Representatives of the Stave River Power Company have been looking over the country with a view of extending a power line at Sumas and to Kendall to furnish power for the cement plant to be started by the Coleman-Evans interests. The plant of the company has a capacity of 45,000 horse-power, and lines are being extended all over British Columbia for the purpose of furnishing power and light. The company also proposes to build an electric line from Vancouver to Sumas Prairie and Chilliwack, and will touch the boundary line at Sumas.

ONEIDA, N. Y.—It is said that a deal has been consummated whereby the stock of the Madison County Gas and Electric Company, of Oneida, has become the property of the Hudson River Electric Power Company, one of whose interests is the Empire State Power Company, which has the contract for lighting the city of Oneida for a term of five years from January 1. By the terms of the sale it is understood that the Empire State Power Company assumes and will use the lines and lamps of the Madison county company, so far as is practicable, in the fulfillment of the contract. The franchise for commercial business, owned by the Madison County Gas and Electric Company, also becomes the property of the Hudson River Electric Power Company, and under its provisions the Empire State Power Company will do a commercial business in the city.

INDUSTRIAL ITEMS.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., has ready for distribution discount sheet No. 848. This sheet will be sent to any one interested upon request.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, Yonkers, N. Y., has ready for distribution a new discount sheet on Habirshaw wires and cables.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, is mailing a striking folder entitled "A Pair of Crooks." This calls attention to the perfect alignment of "Columbia" carbons.

THE SARCO COMPANY, 906 Sixth avenue, New York city, has designed a neat little booklet calling attention to the Sarco Key arm-switch. This booklet will be sent to any one interested upon request.

THE A. & W. ELECTRIC SIGN COMPANY, Cleveland, Ohio, has been incorporated under the laws of the state of Ohio for $25,000. The following officers have been elected: H. J. Walzer, president and treasurer; E. J. Kulas, vice-president, and William Knapp, secretary.

THE AMERICAN INSTRUMENT COMPANY, Philadelphia, Pa., has arranged for a representation in Chicago, Ill., with A. B. Weeks in charge. Arrangements for representation on the Pacific coast have also been made with the Holabird-Reynolds Electric Company, San Francisco and Los Angeles.

M. W. DUNTON & COMPANY, Providence, R. I., are mailing to those interested a folder containing samples of "Red Rope" paper, showing the sizes which are carried in stock for insulating purposes. The firm carries a large stock of this paper constantly on hand in different widths and thicknesses.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., owing to the great increase in orders, removed on November 1 to larger quarters at 420-422 Ogden avenue, Newark, N. J. The company manufactures Germania standard and reflector lamps. It will retain its New York office at 120 Liberty street.

THE SOLAR ELECTRIC COMPANY, Chicago, Ill., entertained Sir Thomas Lipton at the recent advertising show at Chicago, Ill. Sir Thomas expressed himself as very much impressed by the decorative advertising lamps made by this company, and gave an order for a large number of the Canteen globes to advertise Lipton's tea in all parts of the world.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has ready for distribution bulletins No. 1,082, No. 1,083, No. 1,084 and No. 1,085, describing and illustrating, respectively, multiple alternating-current street arc-lighting system, types MA and M induction motors, standard switchboard panels for multiphase generators, and integrating switchboard wattmeters.

THE GOULD STORAGE BATTERY COMPANY, New York city, made an interesting exhibit at the recent appliance exhibition of the American Street and Interurban Railway Manufacturers' Association at Columbus, Ohio. Several single cells for railroad and lighting work were shown, as well as a number of very interesting photographs of Gould installations. The company was represented by R. H. Watson, Chicago; T. Milton, Chicago; H. W. Powers and John Eipper.

THE DETROIT INSULATED WIRE COMPANY, Detroit, Mich., has well under construction a large building which will be equipped as rapidly as possible for the manufacture of rubber-covered wire and cables, lead-covered cables, weatherproof wire and flexible cords. The officers of the company are E. E. Keller, president of the Westinghouse Machine Company, president; J. H. Hunter, of the National Cable and Wire Company, vice-president, and Arthur Hartwell, secretary and treasurer.

THE NATIONAL METAL MOLDING COMPANY, Pittsburg, Pa., has purchased the entire assets, good will, etc., of the Osburn Flexible Conduit Company, and will hereafter control the manufacture and sale of "Flexduct." In order to better serve the interests of customers, all business pertaining to "Flexduct," flexible conduit and "Economy" rigid conduit will be conducted from the headquarters of the company at Pittsburg. C. E. Corrigan, vice-president of the company, will hereafter be located at the general offices in the Fulton Building, Pittsburg, Pa.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is calling attention to its universal portable. This portable combines the desirable features of an adjustable portable, and is light in weight, strong, durable and ornamental. When not in use it may be folded into a small space. There are no screws nor nuts used to tighten the apparatus, and the solid cast base, weighing five and one-half pounds, is heavy enough to keep the portable from being easily overturned. The bottom of the base is felt-covered, so that it will not mar nor injure a polished desk.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has published the tenth edition of "Graphite as a Lubricant." The subject of lubrication in general, and graphite lubrication in particular, are exhaustively treated. In addition to the good features of the previous editions the latest information, both scientific and practical, that has to do with the subject, is added, making the booklet very valuable. This work is arranged and indexed so as to readily enable the reader to find the information he is most interested in. The company will be pleased to send copies of the booklet upon request.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., is building two induced draught fans of exceptional dimensions for the power station of the East St. Louis & Suburban Railway Company. The wheels of the fan, which are overhung, measure nineteen feet six inches in diameter, and are seven feet wide at the tips of the blades. These are believed to be the largest overhung induced draught wheels ever built. They will be driven by Corliss engines, and will be carried on ten-inch steel shafts. They have specially designed two-part spool hubs, which occupy comparatively little space on the shaft, and permit the bearings to be set in close to the centres of gravity of the wheels. Each water-cooled bearing weighs over a ton.

Record of Electrical Patents.

Week of October 16.

833,733. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 23, 1902. Makes use of a consequent-pole, electromagnet device for controlling the call bells.

833,741. ELECTROMAGNET. Hans H. Hansen, Chicago, Ill. Filed May 1, 1905. A magnet suitable for call bells provided with two circuits for carrying dephased currents.

833,745. TELEPHONE TRANSMITTER-ARMS. John A. Loff, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 6, 1901. A method of constructing a pivoted arm.

833,760. REGULATING APPARATUS. Elmer A. Sperry, Cleveland, Ohio, assignor to the Safety Car Heating and Lighting Company. Filed June 6, 1905. A dynamo provided with two commutators, two sets of brushes and means for automatically bringing into action either set.

833,765. SIGNAL SYSTEM FOR RAILWAYS. Maximillian G. Voigtlander, Harrison, Ohio, assignor of one-third to Owen W. Grubbs, Harrison, Ohio, and one-third to Abraham L. Weeks, Harrison, Ind. Filed November 14, 1904. An automatic block system, one rail being continuous.

833,778. FASTENING DEVICE FOR SWITCHBOARD CONNECTING-CORDS. Edward B. Craft, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed December 7, 1904. Provides hooks for supporting the telephone-cord terminals.

833,781. SIGHTING-MACHINE. Bradley A. Fiske, U. S. Navy. Filed January 2, 1904. A target device for training gunners.

833,805. ELECTRICAL SELECTING APPLIANCE. Charles E. Scribner, Jericho, Vt., assignor to Western Electric Company, Chicago, Ill. Filed December 18, 1905. A spring-actuated calling device.

833,816. TELEPHONE-CIRCUIT SIGNALING APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Filed July 3, 1905. Employs an electromagnetic pole-changing switch for actuating the signals.

833,817. TELEPHONE SWITCHING AND SIGNALING APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Original application filed July 3, 1905. Divided and this application filed March 12, 1906. A four-party-line system employing plus and minus bells.

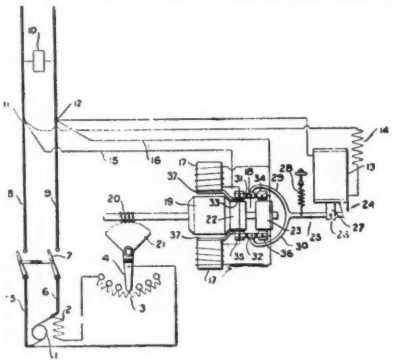
833,866. TELEPHONE SYSTEM. Charles V. Beaver, Anita, Iowa. Filed August 19, 1904. An intercommunicating telephone system which operates by various groupings of a limited number of wires.

833,870. UNDERGROUND CONDUIT. Horace B. Camp, Akron, Ohio. Filed October 3, 1905. A number of hollow members are surrounded by a reenforced cement body.

833,877. INSULATOR. Francis J. Grant, Chicago, Ill. Filed August 12, 1905. Has two arms set at an angle with each other.

833,906. TELEPHONE SWITCHING AND BUSY-TEST APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Filed July 3, 1905. Makes use of a series of relays connecting for two central stations together.

833,907. SIGNALING APPARATUS FOR TELEPHONE TOLL LINES. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Filed July 3, 1905. Provides a supervisory signal at the called central station.



833,760. REGULATING APPARATUS.

833,929. HOISTING APPARATUS. Charles W. Hunt, New York, N. Y. Filed February 7, 1906. Two drums are driven by independent motors.

833,968. ALTERNATING-CURRENT CONTROLLER. David Larson, Yonkers, N. Y. Filed September 28, 1905. Controls automatically the acceleration of the motor by means of two actuators placed one in series and one in shunt.

834,010. ELECTRICAL CONTROLLER. David Larson, Yonkers, N. Y. Filed November 4, 1905. A current controller for a constant voltage system, the controller being a motor with two opposed windings.

834,054. SPARK-GAP AND MUFFLER THEREFOR. Aaron E. Harrison, New York, N. Y., and Crowell M. Haslett, Jersey City, N. J. Filed September 26, 1905. The spark-gap is enclosed in a chamber provided with an outlet to a second muffling chamber.

834,084. HIGH-POTENTIAL INSULATOR. Louis Steinberger, New York, N. Y. Filed March 24, 1905. The insulator, consisting of a number of hoods engaging each other, is supported on a soft rubber bushing.

834,098. ALTERNATING-CURRENT MOTOR. Charles A. Ablett, Schenectady, N. Y., assignor to General Electric Company. Filed July 30, 1903. A motor of the induction commutator type.

834,100. OVERHEAD TROLLEY SYSTEM. Charles E. Barry, Schenectady, N. Y., assignor to General Electric Company. Filed May 1, 1905. The overhead conductors are supported at the side of the road, means being provided for changing automatically from one side to the other.

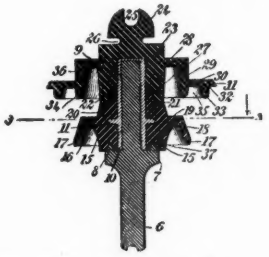
834,104. TELEPHONE BRACKET. Charles H. Borden, Stamford, Ct. Filed August 29, 1905. An adjustable bracket having a parallel movement.

834,128. ELECTRIC SWITCH. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. Filed February 1, 1906. A number of independently movable switches are employed, and means for automatically breaking the circuit if they be closed out of a predetermined order.

834,129. BLOCK SIGNAL SYSTEM. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. Filed April 7, 1906. A train-actuated block signal system.

834,134. TROLLEY BASE. Henry Holland, Cleveland, Ohio. Filed August 5, 1905. The socket is provided with a double fulcrum rest.

834,147. AUTOMATIC MOTOR CONTROL. Sam H. Libby, East Orange, N. J., assignor to Sprague Electric Company. Filed May 21, 1904. The controlling resistance is cut out by a pilot motor.



834,084. HIGH-POTENTIAL INSULATOR.

834,148. TRANSFORMER. Charles E. Lord, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. Filed October 19, 1905. The air, after being forced through ventilating passageways in the core and coils, is passed through a cooler.

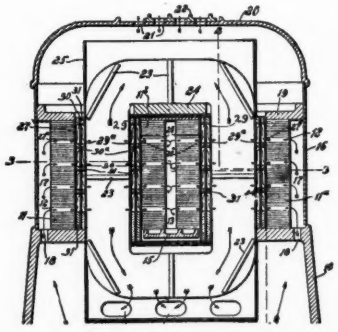
834,160. TRANSFORMER. Louis C. Nichols, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company Filed October 19, 1905. Passageways are arranged so that air passes through the coils in two different directions.

834,162. ELECTRICAL RESISTANCE PYROMETRY. Edwin F. Northrup, Philadelphia, Pa., assignor to the Leeds & Northrup Company, Philadelphia, Pa. Filed June 16, 1906. Employs a low-resistance element.

834,172. VAPOR ELECTRIC APPARATUS. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. Filed July 1, 1904. One of the electrodes is of vaporizable material.

834,175. MAGNETIC ORE SEPARATOR AND CLASSIFIER. Guy H. Waring, Webb City, Mo. Filed November 16, 1905. A series of electromagnets is placed over an inclined trough of nonmagnetizable material.

834,208. TELEPHONE SYSTEM. Charles Kenney and Robert H. Leather, Philadelphia, Pa. Filed April 25, 1904. An indicator is provided with means for connecting it in circuit with any one of the instruments.



834,160. TRANSFORMER.

834,220. METHOD OF MAKING COILS FOR ELECTRICAL APPARATUS. Edward L. Aiken, Schenectady, N. Y., assignor to General Electric Company. Original application filed December 5, 1898, patented February 10, 1903, No. 720,092. Divided and application filed January 31, 1901. Again divided and this application filed August 13, 1902. Flat helixes are wound and the turns separated by a spreader.

834,235. ELECTRIC SIGN. Anatole C. Heiny, New York, N. Y., assignor, by direct and mesne assignments, to Heiny Electric Company. Filed December 15, 1904. A plurality of panels is provided, each having incandescent lamps arranged in fixed groups.